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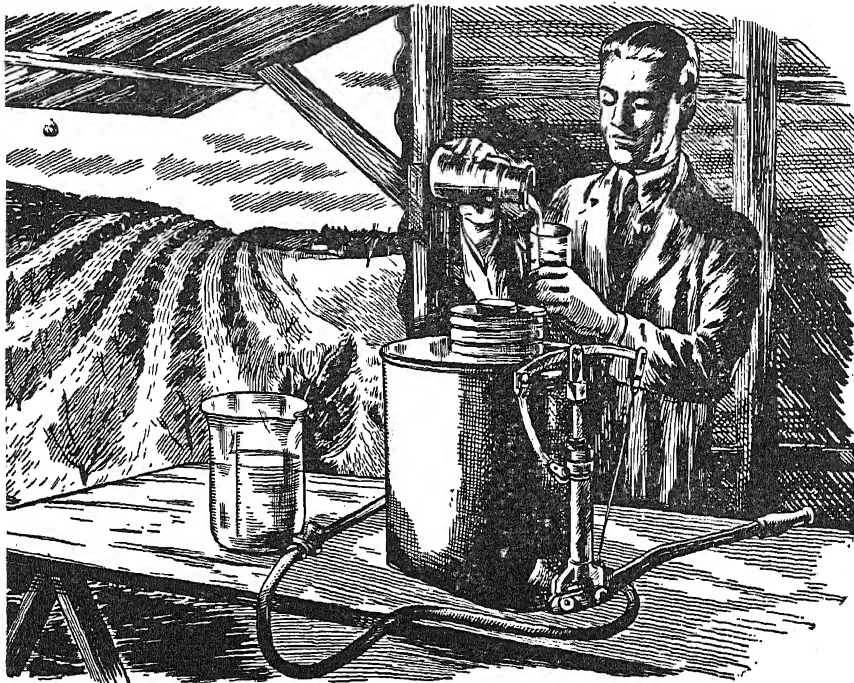
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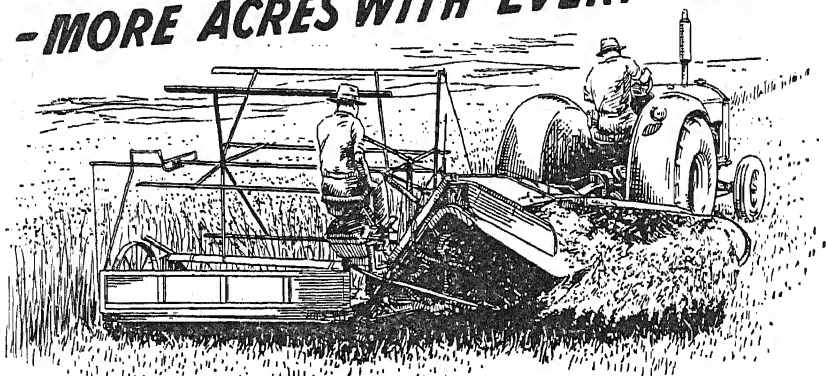
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No. 1.

**An Investigation of the Drought Pastures of the
Murchison District of Western Australia.**

GEORGE F. MELVILLE, B.Sc. (Agric.).

*Being a thesis presented as partial fulfilment of the conditions for the Degree of
Bachelor of Science in Agriculture with Honours.*

INTRODUCTION.

THE need for a better understanding of the scientific principles underlying pastoral management and animal husbandry in the arid to semi-arid pastoral areas of Australia, has long been felt, but not until recent years has any marked progress been made in this direction.

With the inauguration of the arid research station at Koonamore, South Australia, a definite step towards a systematised study of problems connected with arid vegetation and its relation to the grazing animal, was taken.

Previous to this such workers as Cannon (1), Adamson and Osborn (2) and Osborn (4) and Wood (3) had made a study of the subject mainly however from a botanical point of view. Looking further afield to South Africa with somewhat similar problems to our own, we find considerable amount of energy and money expended in the elucidation of problems peculiar to an arid region of pastoral production. Western Australia, possessing as it does some 486 thousand square miles of country that can be classed as arid, presents a problem unique in this regard. Almost 50 per cent. of the State receives a rainfall of less than 10 inches a year which area is confined solely to pastoral pursuits. The great area of pastoral country together with the remarkable diversity of soil and vegetation types opens up a particularly extensive field for investigation.

No apology therefore need be made in presenting an account of investigations which at this stage have been essentially preliminary in nature, and confined to one particular region of pastoral activity.

GENERAL INTRODUCTION ON THE MURCHISON COUNTRY.

The Murchison district of Western Australia, so named after the river which traverses its Western portion, comprises a large triangular shaped area the apex of which cuts the coastline at Shark Bay. This belt broadens as it passes inland in a W. to S.W. direction until it merges into the North-Eastern Goldfields. The district is included in the extensive *Acacia* formation which extends, as a belt of some 200-300 miles wide, from the Western coast at lat. 24 deg. S. in a S.W. direction to the South Australian border. The Southern boundary coinciding fairly closely with the 10 inch winter isohyet is clearly defined by change in vegetation from *Eucalypt* to *Acacia* formation. To the North the Murchison country passes more gradually into the Gaseoyne.



Mulga (*Acacia aneura*) lopped for sheep feed during drought.

The value of this area as pastoral country was not realised until about the 70's of last century when small flocks of Merino sheep were introduced.

The definitely arid nature of the climate of the area had previous to that time proved a deterrent to settlers, but with the realisation of the exceptional wool growing capacity of the natural vegetation together with the discovery of good water at shallow depths, the future of the area for pastoral production was assured. Water supply to stock even in the severest of droughts has never been a serious problem.

Wells were sunk by the pioneers in creek beds where water was usually to be found within 10 feet of the surface. These wells, circular in shape, still remain as relics of pioneering days. They provided water for stock and man after natural pools had dried out. The general practice was to shepherd the stock from pool to pool or well to well using aboriginal labour.

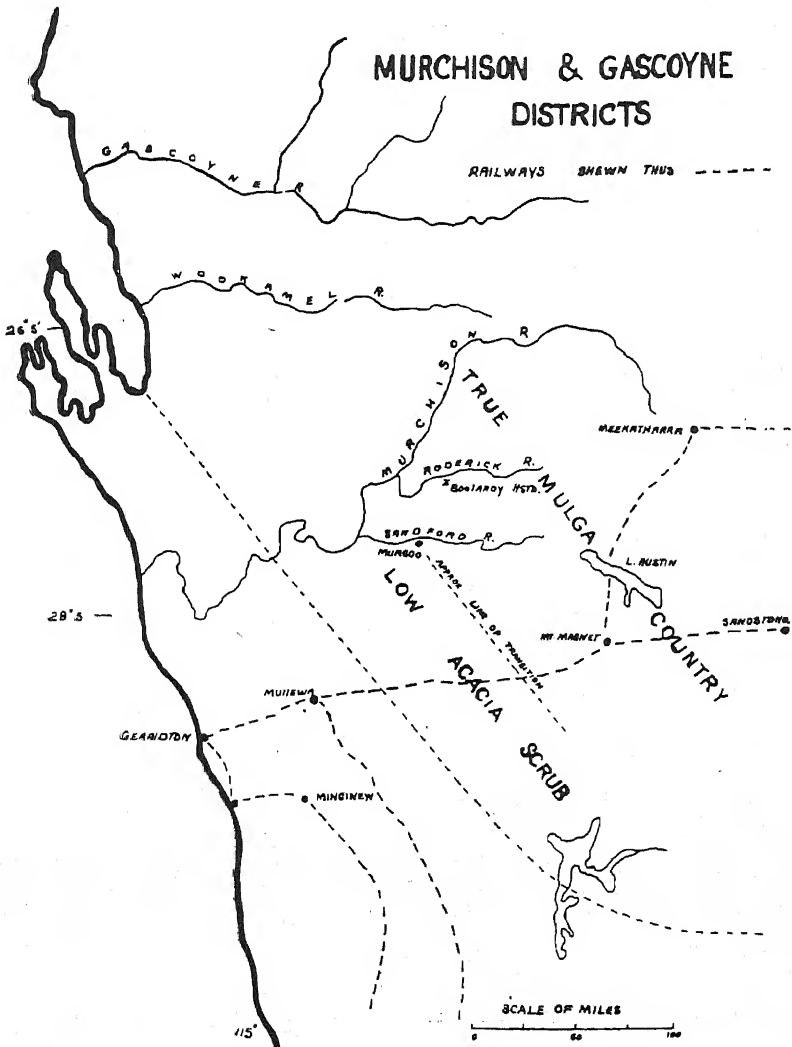
The task of baling the water with rope and bucket was particularly arduous, limiting the size of the flocks to comparatively small numbers. Under this system only a very minor portion of the grazing was utilised, the amount being largely determined by the frequency and location of the pools and wells. That portion of

the country which was utilised was intensely overstocked, which was reflected in the deteriorating vegetation. Evidence of this continual shepherding over confined areas are still to be seen, being marked by tracts of country almost denuded of vegetation.

It was not until the introduction of well-fenced paddocks supplied with watering facilities, that the carrying capacity of the grazing was substantially increased.

The Murchison is singularly fortunate in its water supplies. Good stock water can be obtained almost anywhere in the region from 50-100 feet of the surface. In the Mulga thickets renowned for their excellent drinking water, supplies can be obtained at shallower depths.

Saline waters do occur, especially in the open saltbush country; they are however, quite palatable to sheep.



Geography and Topography.

The monotonous flatness of the country is a feature of the Murchison, or at least that portion West of the Wiluna railway. Except for isolated mesas and buttes which stand out as relics of the old plateaux, and occasional granite outcrops, the country presents a vast level plain blanketed by a covering of low *Acacia* shrubs and trees. The intense flatness is particularly noticeable in the portion North of the Sandford River. To the South of this river the country becomes increasingly undulating in character passing into the sand heaths of the Northern wheatbelt.

Traversing this region is the Murchison river system including its two tributaries, the Roderick and Sandford Rivers, all of which are intermittent in character—only flowing to any extent after heavy falls of rain. After such rains these rivers become raging torrents flooding the country for miles on either side of their course.

The soils of the region are almost universally clay loams of a red to brown colour overlying a hard siliceous hardpan impregnated with red iron oxides.

Teakle (5) proposes that these hardpan soils should be designated as a new soil type and proposes the name of "red and brown hardpan soil." The hardpan lies usually within 6-12 inches of the surface except in depressions where soil accumulation has taken place. The hardpan itself varies greatly in thickness from a few feet up to a hundred feet or more.

From soil profiles exposed on river banks the definitely laminated structure of the pan is shown, also the calcareous intrusions of "opaline" material. In some areas these calcareous deposits outcrop in either isolated patches or belts carrying plant communities typical of such areas.

The occurrence of the hardpan naturally restricts and modifies the root development of the vegetation. A consequence of the presence of the hardpan in the general lateral development of the plant roots. There is however in the mulga quite an extensive development of the tap root which manages even in the very young stages of the plant to penetrate the cracks in the hardpan.

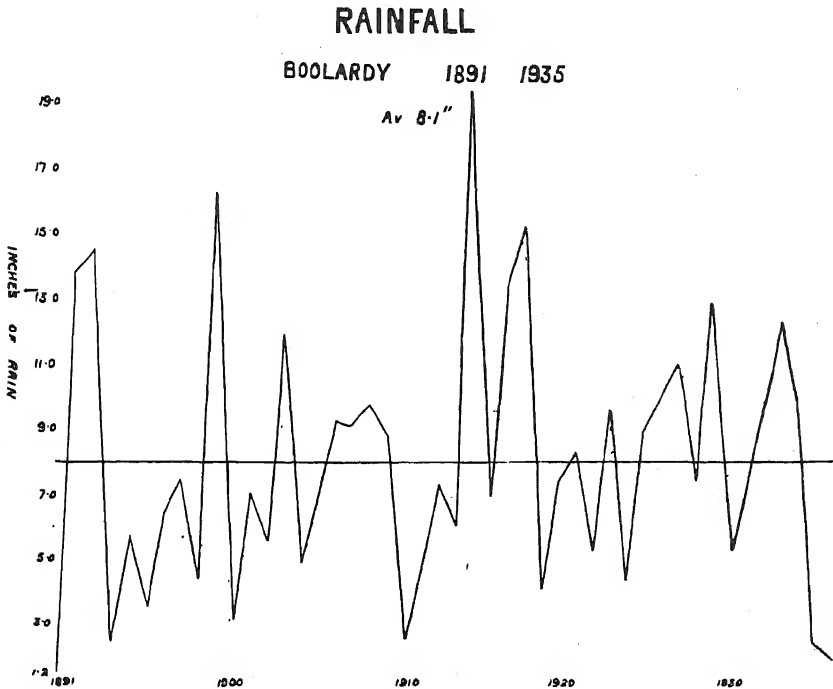
Rainfall.

The rainfall of the Murchison is characterised by its highly intermittent character. Not only is the annual average less than 10 inches but the incidence of the rain is extremely erratic. To give some idea of the differences from year to year in the annual totals some figures from the Boolardy records are given. Boolardy Homestead is situated on the Roderick River and receives equal summer and winter rainfall. The maximum annual total for this station during the last 45 years is 19.4 inches, whereas the minimum is as low as 1.2 inches.

From this it can be seen that the average figure for the 45 years of 8.1 inches gives little indication of the effectiveness of the rain. Generally years of drought are followed by plentiful rains which have the effect of restoring the annual average. Intense drought such as has been experienced during 1935-36 is fortunately of rare occurrence but lesser droughts and "light" years are only too common. The highly xerophytic character of the vegetation bears this out.

The accompanying chart illustrates the great variation from year to year in the annual rainfall, also the fact that three out of every five years are below the yearly average of 8.1 inches.

A point to be recognised is the large number of small ineffective falls which have little or no effect upon the vegetation. A fall of 50 points, if not followed within a day or two by further rain, is almost useless. The large numbers of such falls during certain years are liable to give rise to a misinterpretation of the effectiveness of the yearly total.



Vegetation.

The vegetation of the Murchison district is composed almost entirely of *Acacia* species being termed generally as "Acacia Semi-desert Scrub." The Eucalypts, so frequently met with further South within the 10 inches isobyst, are here confined entirely to the more favourable spots along creeks and rivers.

Within the *Acacia* formation two definite types of country can be recognised:

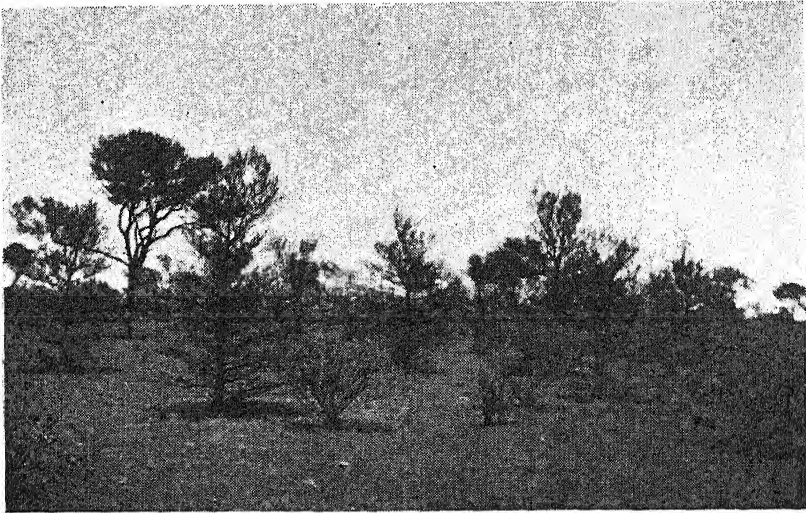
1. The Southern portion extending from the Eucalypt formation Northwards to the Sandford River.
2. The Northern portion extending Northwards from the Sandford.

1. In the Southern region the undulating country is covered by an exceedingly dense growth of shrubs which rarely exceed 8-10 feet in height. The density of the vegetation is a striking feature of this Southern region. The true mulga of the North with its tree-like form is absent. Rainfall in this region is mostly of winter incidence and summer rains, when they do occur, do not produce a dynamic effect on the vegetation as they do in the Northern areas.

The most common shrubs of this area are the Snakewood (*Acacia eremaea*), Minerichi (*Acacia grasbyi*), Jam (*Acacia burkittii*), Curara (*Acacia tetragonophylla*), the Black Wattle (*Acacia sclerosperma*) and Sugar Brother (*Acacia*

brachystachya). Within ten miles of the Sandford River the transition in the vegetation appears to take place. The jam tree and wattles which were previously so abundant become more and more confined to the watercourses whilst the tree-like forms of true mulga take their place. A transitional belt extends roughly from the Sandford to the Roderick River.

2. North of the Roderick River the vegetation takes on a new aspect entirely. Whereas in the transitional belt mulgas occurred in isolated groups they now form definite belts and thickets and dominate the vegetation giving the country a park-land appearance. The density of the vegetation of the South is forsaken for greater height of the individual shrubs typical of the true mulga country.



Mulga country after regeneration.

The importance of differentiating between these two types of country cannot be overstressed as the pastoral problems of the two areas, depending as they do chiefly on the type of vegetation, are in no way comparable to one another.

Pastoral Development.

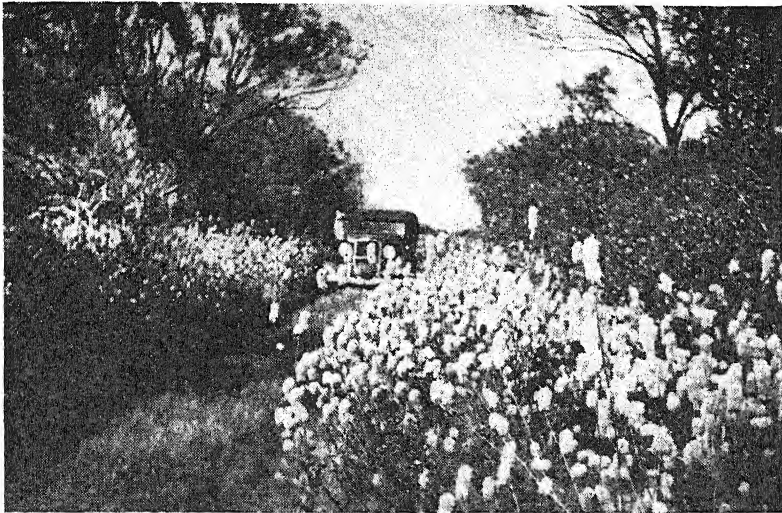
Due to the irregularity of rainfall, agricultural pursuits are non-existent in the *Acacia* formation. The area is solely devoted to pastoral activity, which is based on the natural grazings (mostly top-feeds).

The region forms one of the most important sections of the State's wool producing areas. Some three million sheep are carried, production being confined to wool except for the yearly culls which are sold at the nearest rail head. Heavy culling in good seasons is practised by most pastoralists who aim at producing good constitution sheep able to withstand the lean drought years.

The pastoral holdings, held on lease from the Crown, and known as Stations, comprise areas ranging from 200,000 acres to one million acres, divided into paddocks of 10-30 square miles or even larger.

The paddocks are in most cases well watered, few points being more than three to four miles from a drinking trough. Windmills supply the power to pump the water from comparatively shallow depths into storage tanks, from whence the water gravitates to the troughing system.

This equipment requires constant attention during the dry season whilst the stock are solely dependent on the mills for their water requirements. During the good season creeks and surface pools relieve the mills. Visits are made at least twice weekly to each windmill when troughs are cleaned and working parts of the equipment tended.



Mulga country after rain showing ephemeral growth of *Trichinium alopecuroides*.

The stock are allowed a very wide range of country, 20 acres to the sheep being regarded as the stocking capacity. During drought periods one sheep to 50 or 100 acres is perhaps the total capacity of the country.

The feeding habits of the sheep largely depend on the season. During the good season when grass and herbage are plentiful the sheep show their gregarious tendency and travel in flocks, but during the dry periods when feed is scarce, top-feeds providing the sole picking, groups of two or three or quite often solitary sheep are seen. Seldom does one see groups of more than six or eight.

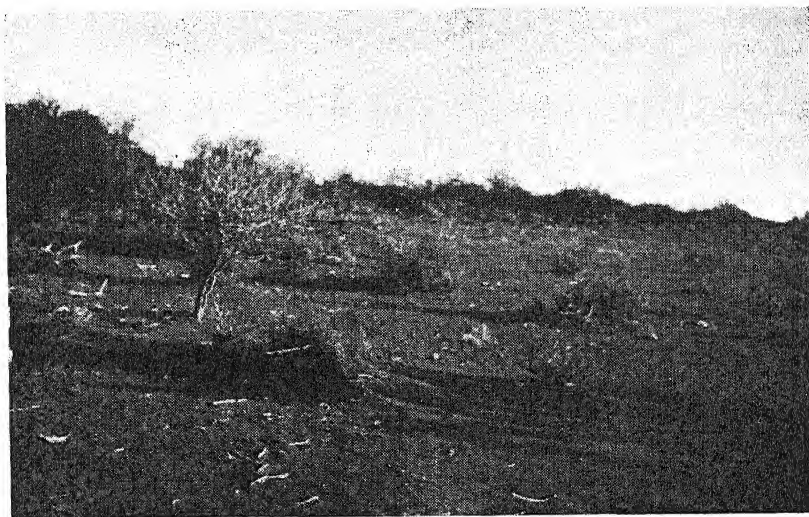
The amount and quality of the top-feeds are the limiting factors controlling the productive capacity of this region. The ephemeral growth while providing a flush of feed, is very spasmodic in its appearance.

ECOLOGICAL SURVEY OF AN AREA ON THE RODERICK RIVER.

When the investigation was initiated it was decided that a specialised survey of a typical section of the country should be made to give some idea of the type of vegetation occurring; also information relating to its frequency, distribution, relation to topography, edibility, accessibility and general pastoral utility. The desir-

ability of having such an area for future reference was also considered. The survey was carried out during the depths of a drought when the more resistant perennials constituted the entire vegetation.

For various reasons it was thought desirable to conduct the survey in the vicinity of the Boolardy homestead, and after preliminary observations an area, intersected by the Roderick River and comprising several small paddocks, was selected as most representative of the vegetation types found on the station. The area was particularly suitable in illustrating the transition from arid shrub steppe open country into the mulga thickets of the flood plain which constitute the two main types of country in that part of the Murchison.



Windswept flats showing denuded bushes of *Curara* and *Kochia* spp.

Methods of Investigation.

The area was traversed by running a series of transect lines with the aid of a prismatic compass, at intervals of some 200 yards, using the fences as reference points. Distances were measured by pacing.

All plants occurring within 2-3 yards either side of the transect were noted, together with particulars as to height, edibility, etc.

Changes in soil character and topography were extremely gradual throughout the area, but where such changes were sufficiently marked to be observed, they were noted.

From this data the vegetation map included with the text was compiled, giving the extent of the more important plant associations. Reference will be made to this map (see page 12) in the description of the vegetation of the surveyed area.

Topography.

The general fall of the country, as can be seen from the course of the rivers and various creeks, is in a South-West direction. There is also a slight fall to the North-Western corner. To the South the area passes into a flood plain bearing typical mulga thickets.

Two main regions may therefore be distinguished—

1. The higher open country of the Northern portion (including almost the whole the Stud Ewe paddock).
2. The lower flood plain of the South (including Orlbinger and Nungully paddocks).

1. *The Higher Open Country of the Northern Portion.*

In the higher country the relationship between topography and vegetation is most marked. On the rises where the soil layer is generally thin the vegetation is spare. Mulga only occurs in the most favourable positions such as the headwaters of creeks and small depressions where accumulation of soil has taken place.



Mulga regeneration.

The higher country may be subdivided into four main habitats, each bearing a typical plant association.

- (a) *The General Plain*—Shown on the map as a broad belt following the course of the Roderick River. The general impression of this habitat is an expanse of perfectly level country covered by a mantle of varying density of low shrubs or herbs growing little more than two feet in height. *Kochia*, *Atriplex* and *Rhagodia* species are the most common plants, the former predominating. The *Kochia* spp. produce robust bushes, whilst the *Atriplex* spp. with their slender stems of trailing habit appear to be much more readily eaten out. It is possible that the preponderance of *Kochia* spp. is the result of stocking Flannel bush (*Solanum ellipticum*) together with odd clumps of Fuchsia bush (*Eremophila maculata*) and Cotton bush (*Trichinium obovatum*) also make an appearance. All three of these bushes are particularly edible and drought resistant.

Various species of Cassia chiefly *C. eremophila*, *C. desolata* and *C. Sturtii* which are to be found quite abundantly in most of the drier habitats, find a place amongst the "salt" bushes. The Cassias generally are inedible and except for the seeds, they produce little of value as stock feed.

Dotted about the plain are plants of more mesophytic character which have apparently survived in a spot where water relations are more favourable. Isolated mulgas of a variety typical of this habitat together with Black Wattles and *Acacia victoriae* (known by the natives as Wallibudda) find such spots suited to their requirements.

The mulga of this region is a low-growing rather stunted tree bearing terete or very slightly flattened phyllodia which are very edible to stock, as evidenced by the way these trees are eaten up as far as the stock can reach.

The Black Wattle (*Acacia scleresperma*) which at all times appears green and fresh is almost always associated with limestone outcrops. Their bright green colour, isolated in surroundings of dull greys, forms a striking contrast to the rest of the association.

Although the drainage of the surrounding country is generally well defined, there are relatively small basins on the plain that appear to have inadequate drainage. In such depressions the water lies till it evaporates leaving an accumulation of salts on the hardpan formation. To the South of the Roderick River on the saltbush plain these hardpans are particularly numerous. Surrounding these bare pans the sage bush (*Kochia* spp.) is particularly abundant. Other depressions occur on the plain, but unlike the former they carry abundant vegetation, appearing as oases in a "desert" of saltbush. Here Curaras (*Acacia tetragonophylla*) and Mulgas (*Acacia ramulosa* and *Acacia aciphylla*) predominate, with Needlewood (*Acacia cyperophylla*), currant bush (*Scaevola spinescens*) and other shrubs, more often associated with more favourable habitats, which find such patches suited to their growth requirements.

Apparently in these depressions subterranean drainage precludes clay pan formation. Soil accumulates due to water and wind action, and is bound together by the roots of the plants, forming a reservoir for the reception and storage of water. Rain falling in surrounding areas is concentrated by run off into such patches; thus only a few points are sufficient to cause the inhabitants of these "oases" to burst into new life producing flowers and foliage whilst the surrounding vegetation remains in its dormancy.

A plant outstanding for its extreme drought resistance and value as a stock feed is the "Currant bush" or Box (*Scaevola spinescens*) which occurs in this habitat. It withstands drought and heavy stocking extremely well, remaining green and succulent throughout the driest periods.

The Wallibudda (*Acacia victoriae*), or as it is popularly called by pastoralists the "Acacia," is another bush which deserves mention. It appears to favour limestone patches, occurring in clumps or as isolated bushes throughout the habitat. There appear to be several closely allied species varying in edibility.

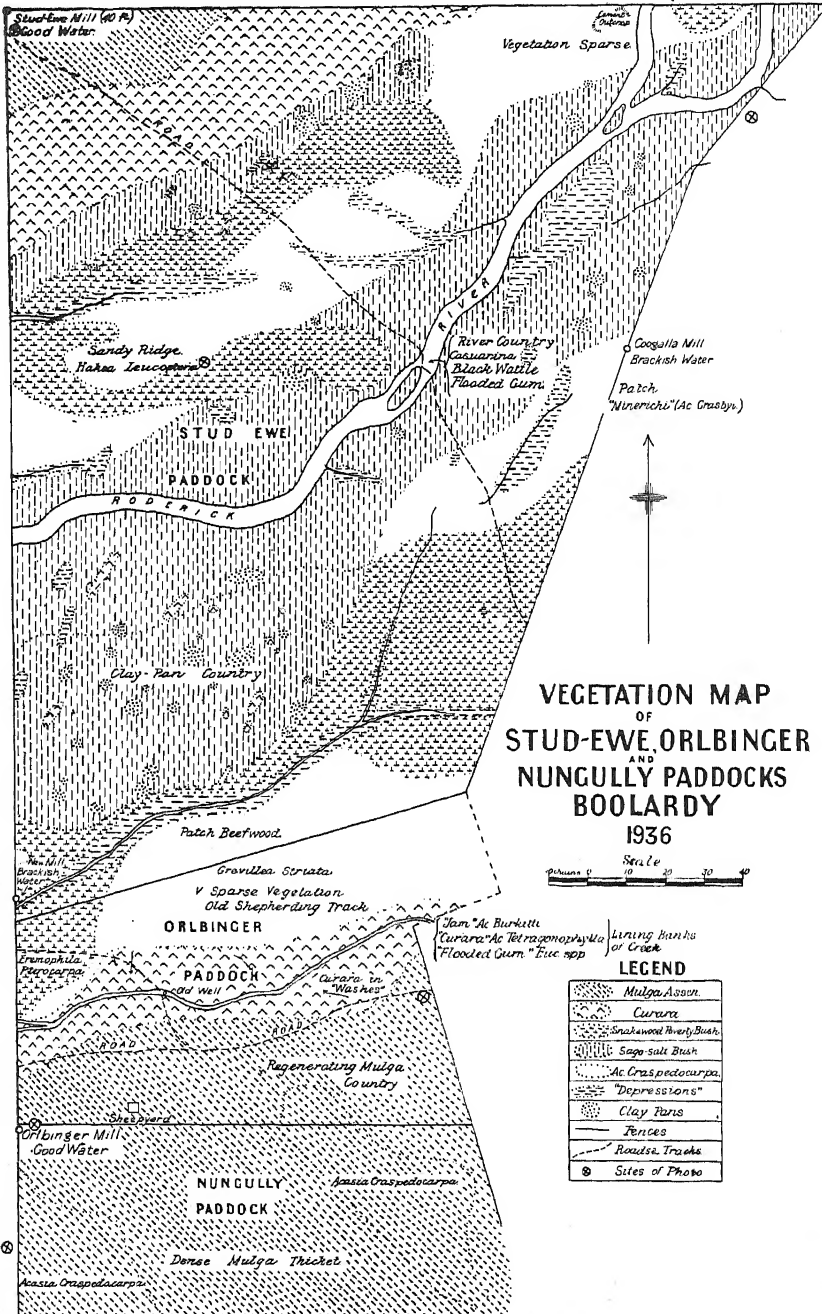
As with quite a number of the bushes of this association the feeding habits of the sheep with respect to the "Acacia" bush are rather spasmodic. There appear to be certain times at which the sheep relish them and others when they do not touch them.

The association of the plain consisting as it does of low growing bushes of high edibility and frequent occurrence, provides a great amount of feed, and possesses probably the highest stocking capacity of the various plant associations. During the drought however, the whole plain has been practically defoliated making it extremely difficult to distinguish between the species. With the lightest falls of rain however, this association responds to a remarkable degree providing quite good picking for some weeks.

- (b) *Higher Country*—Occurs extensively in the Stud Ewe paddock to the North and South of the saltbush belt.

On passing from the plain to the higher country (there is actually little in altitude) the vegetation changes in composition, becoming sparser with little or no undergrowth. The habitat carries a plant association of the most xerophytic character. The Snakewood (*Acacia eremacea*) known by the natives as Bilya, together with Poverty bush (*Eremophila pterocarpa*) are the predominating shrubs. The soil layer is very shallow and the edaphic conditions generally are such that this habitat capable of supporting only the most xerophytic species. On the fringe of the association the Fuchsia bush (*Eremophila maculata*) and Cotton bush (*Trichinium obovatum*) form a sparse ground covering. But as one proceeds into the association the undergrowth disappears leaving the ground extremely bare in between the Snakewood and Poverty bushes. The Fuchsia bush mentioned above has been named as a poison plant, but in the region under discussion the bush was extremely well eaten. Whether it had any deleterious effect on the stock is not known.

The Snakewood grows to a shrub of some 10-12 feet in height, producing a dense canopy of broadly lanceolate *phyllodia*, which are held vertically by the numerous small branches arising from a short main trunk. The *phyllodia* are very fibrous and almost totally inedible and practically inaccessible, but the pods when produced are sought after by stock. The Snakewood is not confined to this habitat and may be found occurring extensively in the lower lying areas surrounding clay pans. In general it may be said that the Snakewood occurs in those habitats least favourable to the growth of more xerophytic plants such as mulga.



The Poverty bush (*Eremophila pterocarpa*) forms the major part of the association occurring more widely and frequently than its associate. Its xerophytism is even more marked than in the case of the Snakewood. Of a more bushy habit, it seldom exceeds 6-8 feet in height producing a mass of small, dull green succulent leaves. Due to their very strong taste and odour, however, they are not eaten except in the deepest drought.

During this year the stock have seemed to take to this bush apparently having acquired a taste for it in the absence of better feed. During drought it is one of the very few shrubs within reach of stock which still bears foliage.

Considering the wide distribution of the Poverty bush, its great drought resistance and the fact that stock will eat it during the dry times, it appears quite likely that its value as a stock fodder has been underestimated. As on the plain, patches of Curara and mulga of very limited extent do occur in favourable patches where the soil is deepest.

- (c) *The River Country*—In the area under discussion the course of the river is extremely well defined by banks dropping almost vertically from the level of the plain. The course of the river is marked by a green ribband of vegetation some hundred yards wide which contains a number of genera restricted to this habitat. Perhaps the most prominent tree is the *Casuarina* which forms dense thickets following the bed of the river. It attains a height of some 20 or more feet producing a dense mass of dark green foliage which is quite edible but is largely inaccessible. Towards the banks the Black Wattle predominates with a few Flooded Gums producing their ghostly white trunks. The Black Wattle is particularly well eaten by stock. Of the halophytic species of plants the Samphire and Saltbush (chiefly *Atriplex rhagodioides*) predominate and form a band lining the salt encrusted river bed. This belt is succeeded by the Black Wattle and Eucalypts which extend to the level of the plain. Other genera of less importance find this habitat favourable to their growth. These include several *Grevillea* species, *Cassias* including the edible *Cassia chatelainiana*, *Scævola* spp. and *Eremophila pantoni*, a so-called Poverty bush occurring quite frequently on limestone ridges. Its beautiful blue flowers are a source of admiration. A conspicuous absentee from this habitat is the mulga which is singularly intolerant to salty localities.

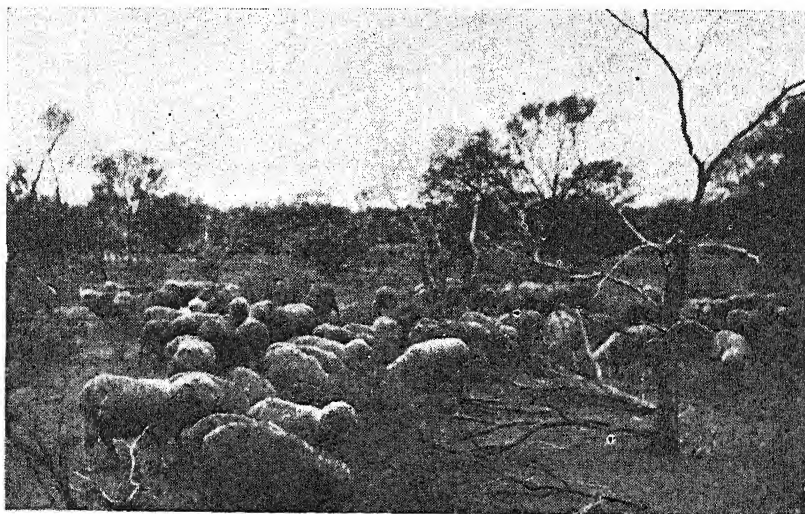
The value of the river country during drought, notwithstanding its very limited area, must be appreciable considering the density and fairly high edibility of the vegetation it carries.

- (d) *The Smaller Streams and Washes*—The drainage channels and "washes" are particularly well marked by the way in which the vegetation is clustered about their margins forming belts of vegetation which stand out prominently from the surrounding country. Particularly is this so on the saltbush plains where the drainage channels are clearly defined by the belt of Curaras and mulgas associated with them.

In these watercourses soil accumulates and is bound together by roots and refuse from the trees. The water-retaining power is increased, making such localities favourable habitats for the growth of denser

vegetation. On reviewing these streams from their source up to the point at which they join the river one is particularly struck by the succession of plant species.

At the source of the stream where the water of the catchment area is concentrated to form a definite depression the mulgas of various species predominate. Further down the stream at a point where a definite channel is distinguishable the Curaras (*Acacia tetragonophylla*) begin to take the place of the mulga until a point is reached at which the mulga disappears and the Flooded Gum takes its place as an associate of the Curara. As the channel continues to become better defined the vegetation as well as changing in character, also changes in intensity being restricted to the banks lining the channel. From this point until the stream enters the river the vegetation increasingly resembles the typical river vegetation described above. It appears possible that this succession of species is related to the increasing salinity of the water. This phenomenon is most obvious in the streams flowing through saltbush country. In the streams flowing through mulga country the "Jam" (*Acacia burkittii*) Curara, and scattered mulgas are the chief vegetative types occurring along their banks.



Sheep feeding on lopped Mulga.

2. *The Lower Flood Plain of the South.*

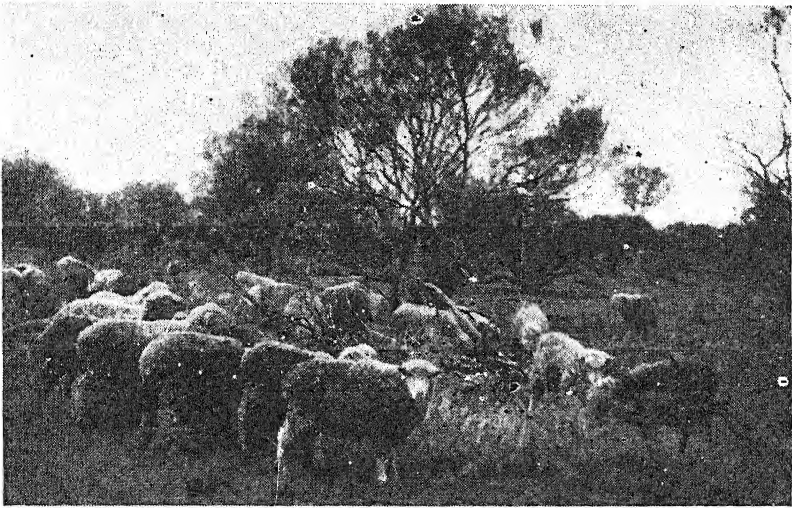
This habitat is the home of the Mulga, where it occurs in dense thickets almost to the exclusion of other species. The fringe of such an association is shown in the Southern-most portion of the map.

The line of demarkation from the open country to the flooded areas is most marked. One is first struck with the increased density of the vegetation, the greater proportion of which attains tree-like proportions in the latter habitat. Several factors related to the topography have the effect of making this habitat a favourable situation for the growth of the more xerophytic plants. The water relations of the

lower lying land are more favourable due to run off from the surrounding country. Also due to the greater depth of soil the water retaining power of the area is greater. These factors have a marked effect on the resulting vegetation.

The Curara (*Acacia tetragonophylla*) grows to a larger size in this habitat and is particularly abundant, lining the washes and small water courses where the water relations are most favourable. The bushes are of spreading habit attaining some 10-12 feet in height and covering the ground for more than 10 feet around the trunk with their trailing stems, carrying the small spiny phyllodes so relished by stock.

This bush, due to its occurrence in practically all plant associations of the area, together with its high edibility, is quite the most important fodder plant on the Murchison. Unlike most of the plants of this region the production of resinous secretions and protective hairs is negligible; its response to drought conditions being the loss of its phyllodia.



Sheep feeding.

Its value as a stock feed during the most critical periods is therefore greatly reduced. However, with the smallest falls of rain the apparently dead bushes burst into life, providing valuable feed at a time when most needed.

A belt of Curara is shown occurring in the North-West corner of the map. This belt marks the termination of a creek which at this point loses its identity and spreads its waters over the flood plain. The general vegetation of the flood plain is however Mulga, which in this habitat attains its greatest development. The uniform size of the trees together with their regular spacing gives one an impression of an orchard; this impression is further enhanced by the regular canopy-form of the tree tops.

In the denser thickets the Mulga precludes competition from the other shrubs, occurring as pure communities. In the clearings between the thickets species of *Cassia* and *Eremophila* (chiefly *E. Fraseri* and *E. Leucophylla*) together with Curara (*Acacia tetragonophylla*), Currant bush (*Scaevola spinescens*), Sandalwood and other minor shrubs find a place suitable to their growth.

A shrub which deserves mention here is the so-called "Poverty bush" (*Eremophila leucaphylla*) which occurs in most habitats but perhaps most profusely in association with the Mulga. The bush is of low-growing habit, rarely exceeding five feet in height and bears excessively hairy leaves which give the plant a felty appearance. Unlike most of the *Eremophila* species the production of "lacquer" is negligible, there apparently being an exchange with loss of secretion and formation of the felty covering.

Opinions regarding its edibility vary, but from observations it appears to be quite palatable to sheep. It is extremely drought resistant and with the first rains produces a wealth of succulent shoots which are relished by stock. From chemical analysis the feeding value is particularly high especially with regard to the protein fraction (15 per cent.).

Taking the association as a whole its stocking capacity is low. The dominant constituent, the Mulga, is almost entirely inaccessible and contributes very little in the way of stock feed except for fallen leaves and pods.

Unless this vast supply of topfeed is made available by lopping or cutting its pastoral value must of necessity be low. The value of this naturally conserved fodder for use in times of drought is a point which is not generally recognised. Regarded as a standby fodder the value of the Mulga to the pastoralist is inestimable.

A frequent inhabitant of the flood plain is the *Acacia craspedocarpa* known by the natives as Thadangu. It occurs in thickets in almost pure communities. Such a thicket is shown occurring in Nungully paddock in the Southern most portion of the map.

The phyllodia of this shrub are broad, very thick and fleshy, and are produced very abundantly giving the bush a density of foliage rarely found in this region. When in flower the shrub presents a most beautiful sight with its abundant clusters of bright yellow wattle blossoms. The pods which are broad and long, some being as much as three inches in length, are sought after by natives and stock for the seeds they contain.

The spreading habit of the shrub, which often attains 15 feet in height, precludes the existence of any undergrowth. In a good season, after March or April rains, ephemeral growth consisting chiefly of Mulla mulla (*Trichinium* spp.) covers the ground providing a wealth of feed. It is in such country that in past years some of the feed has been cut for hay. The impossibility of using a machine for the purpose, and the labour required for cutting any quantity with a sickle, has deterred the pastoralist from any extensive scheme of hay cutting.

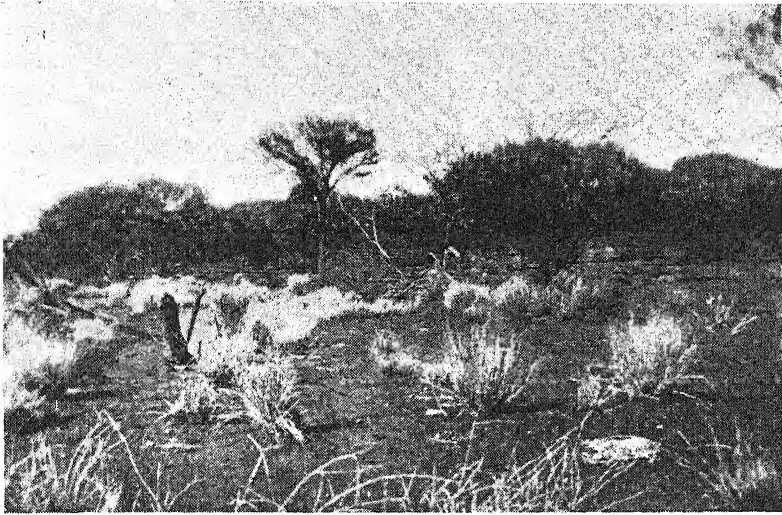
The Thadangu itself is, except for its seeds, practically useless as a stock feed, due to its almost total inedibility. Even in the worst droughts the stock do not seem to touch it.

A shrub which does not really belong to the flood plain but which is found in locations on the fringe of the Mulga thickets is the Minerichi or Redwood (*Acacia grasbyi*). This shrub, growing to 10 to 12 feet in height is particularly easy to recognise by its red scaly bark which peculiarly enough is eaten by horses. The wood is very heavy and burns well even in the green state.

The Minerichi occurs more frequently in the South Murchison where it forms large communities, while in the true Mulga country its occurrence is generally

sparse. The bush is not very edible, nor is it particularly accessible. The phyllodia are very hard and fibrous and some pastoralists hold the opinion that it causes digestive troubles in stock.

A belt of vegetation consisting chiefly of this shrub commences just South of the Coogalla mill and extends in an Easterly direction before passing into sparse Mulga.



Association of Bowgada (*Ac. linophylla*) and grasses *Eriachne* spp. on Wandarrrie country.

An association which was not included in the area surveyed but which deserves attention here, seeing that it occurs quite frequently on the Murchison, is that of the Bowgada bush or Wandarrrie. Such "Wandarrrie" patches, as they are called are associated with a definite soil type, which is of a rather loose texture composed of large particles or grains; the soil has a general appearance of immaturity. The soil layer is deeper than in other habitats and for this reason such areas are often chosen by pastoralists for homesteads and garden sites.

The Bowgada (*Acacia linophylla*) is easily recognised by its peculiar globular shape and its fine terete phyllodia. The pods also, are very characteristic resembling lead pencils in form. The seeds they contain are readily sought after by sheep.

Associated with the Bowgada is a perennial tussocky grass (Wandarrrie grass) *Eriachne* spp., which was seen to occur only in this habitat.

The Wandarrrie country appears particularly suited to the growth of perennial grasses.

A peculiarity about the association of the grass and the Bowgada is that they do not occur intermingled one with the other as may be expected, but the grass occurs as a definite patch or belt surrounded by or bordering the belt of Bowgada.

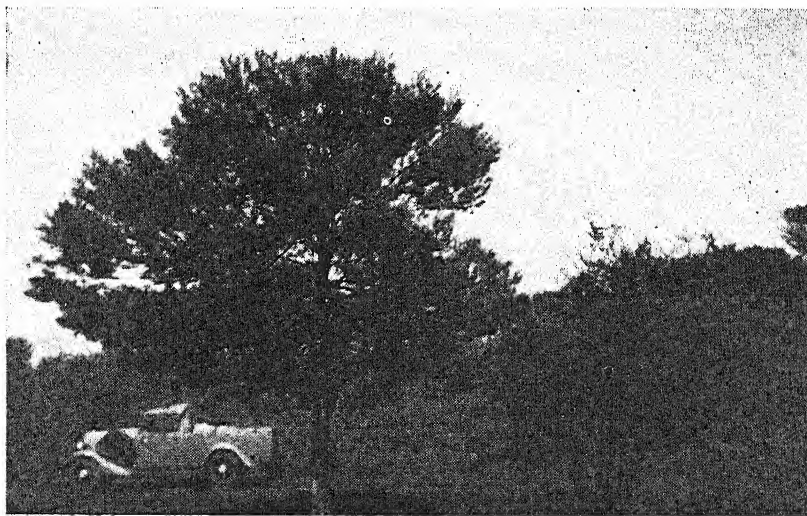
Opinions regarding the edibility of this *Acacia* appear to differ widely from station to station, but from observations on Boolardy it would seem that the edibility is decidedly low. Being comparatively low-growing in habit of growth the lower

branches of the shrub are quite accessible to stock, but only in isolated places have been seen to be eaten. When forced on to it, as when confined to holding paddocks during shearing, sheep will eat it.

4.—FIELD STUDIES IN MULGA.

The term "Mulga" is generally applied to describe the *Acacia* formation which extends in a rough East-West direction dividing the Northern summer rainfall areas of the State from the winter rainfall areas of the South.

Gardner and Kessell (6) show the formation as extending from North of the Nullarbor plain in a rough North-West direction to cut the West coast between latitudes 22° and 26° S. The belt includes the North-Eastern Goldfields, Murchison and West Gascoyne country.



Mulga (*Ac. aneura*) Typical mature form.

Mulga in the aboriginal tongue denotes hardness and is aptly applied to the extremely tough woods of the *Acacia* trees and shrubs of this arid region. From the pastoralist's point of view, however, it is better to confine the term to the tree-like forms of *Acacia*, occurring in the more Northern portion of the formation, coinciding with the increasing incidence of summer rainfall. In this paper the term Mulga will be confined to the tree-like *Acacias* of the Northern Murchison and not to the low *Acacia* scrub of the South.

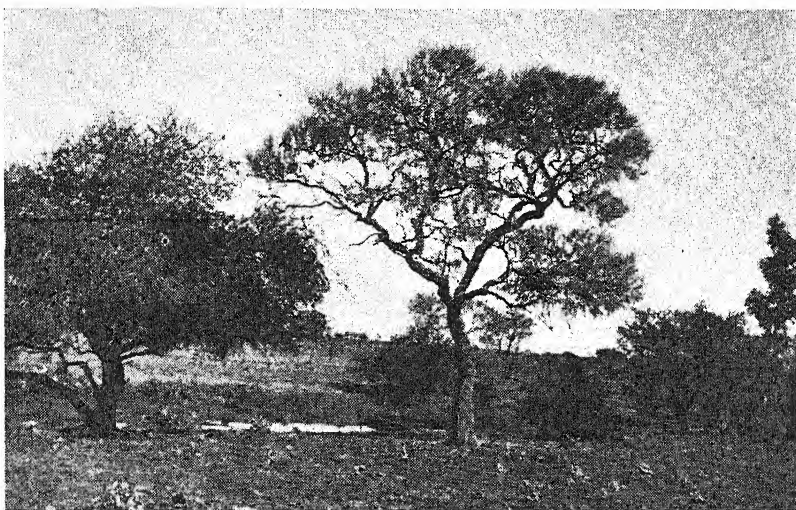
The true Mulga, most forms of which appear to have the botanical characteristics of *Acacia aneura*, includes many diversified forms, which however, are all characterised by their tree-like habit of growth, their possession of terete to slightly flattened phyllodia and their cylindrical spikes of bright yellow flowers. Greatest variation occurs in the form of the phyllodia depending to some extent on the season, and the water relations of the habitats in which the individuals grow, but chiefly depending on specific or varietal characters. It appears possible that hybridisation has produced intermediate forms.

The possession of a main stem or trunk which rises to some 8-10 feet before producing a canopy of leaves and stems, distinguishes the Mulga from other *Acacia* of the formation. In some cases the stem rises vertically, bearing almost

horizontal lateral branches. This type is usually known as "Pine Mulga" due to its striking resemblance to this tree in its mode of growth. Other forms are less symmetrical in appearance, somewhat resembling the willow.

In contrast to the Mulga the Minerichi (*Acacia grasbyi*) and the Snakewood (*Acacia eremaea*) possess no main stem or trunk, the stem branching almost from the base and bearing a canopy of leaves some 5-10 feet above the ground. These shrubs displace the Mulga in the Southern Murchison.

Although, botanically, the Mulgas are apparently most difficult to classify, from the stock feeding point of view, they differ to a great degree. This difference is associated with edibility which is markedly varied within the several species or varieties. Some types are relished by stock, others are almost totally inedible.



Curara (left) and Hakea spp. on bank of watercourse.

Much information was gained on this point during a stay of some two weeks in an area where Mulga was being cut to feed sheep. Close observation of the feeding habits of the animals was possible giving the observer an accurate idea of the preference shown by the sheep for the various forms of Mulga.

It was at once apparent that certain types were decidedly more palatable to the sheep than others and furthermore that a definite range in edibility could be traced out. The definite selective grazing of the sheep was most impressive. First, the most edible type would be eaten out, the sheep rushing these bushes as they fell; then the sheep would go back through the felled patch and eat out the less edible types in a definite order leaving perhaps odd bushes of a most inedible type.

From cursory observations there appeared no explanation for this marked variation in palatability but after closer acquaintance with the vegetation it was noticeable that the Mulgas had for the most part a resinous covering over the phyllodia and stems giving these organs a somewhat varnished appearance. Others again possessed a whitish bloom which again appeared to have the possible function of reducing transpiration.

The various sub-species or varieties of Mulga varied greatly in their ability to elaborate this resinous-like principle, the extent of this varietal character largely determining the habitat of a given variety's most abundant growth. For instance, one found that the tendency was for the more edible species to be more numerous in the vicinity of watercourses and depressions where water relations would be most favourable. Conversely, varieties better adapted to production of the resinous exudate were found more abundantly on the drier slopes.

It was soon apparent that there was a correlation between the edibility of a variety and the amount of the protective secretion. The bushes possessing a shiny, varnished appearance were invariably inedible whilst edibility increased with decrease of this elaboration.

These generalised remarks on field observations have been to some extent substantiated by chemical analysis of samples obtained from the scrub-cutting areas. In these analyses comparisons have been based on the ether extract fraction. While not including all the exudate the ether extract should be a guide to the relative amounts in the various samples.

The table of analysis given below is for samples collected in two paddocks on Boolardy Station.

Samples of the various Mulgas were taken whilst the sheep were eating, notes being taken on each with regard to edibility.

TABLE I.

*Samples from Long Pool Paddock.**Samples from Bilaby Paddock.*

No.	Ether Extract.	Notes on Edibility.	No.	Ether Extract.	Notes on Edibility.
1	6.5	Most edible Mulga in the area	1	5.7	Most edible Mulga
2	9.5	Much less edible than 1 ...	2	7.1	Quite edible, but less preferred than 1
3	10.6	Eaten, but less edible than 1 or 2	3	8.2	Fairly well eaten but of lower edibility
4	10.0	Not very edible ...	4	8.9	Low edibility
5	11.7	Very low edibility. Sheep do not eat except when forced on to it	5	7.32	Low edibility
6	12.0				

From the above analyses it can be seen that there is a definite correlation at least between the amount of the ether extract fraction and the edibility of the various Mulgas. Another point is that the Mulgas in the particular portion of the Long Pool paddock were generally inferior to those in Bilaby. This was realised by those on the scrub-cutting, and it was recognised as inferior country.

According to field observations the amount and nature of the resinous principle depends on:—

1. The age of the plant.
2. The variety of Mulga.
3. Seasonal conditions.

Points 3 and 2 have been discussed above and need not be further considered.

1. *Age of the Plant.*

In the young plant the reaction to drought and adverse conditions generally is most prominent and the secretion from the glands on trichomes is at a maximum. The root system, although well developed even in the youngest of plants, must of necessity be entirely inadequate during periods of prolonged drought. The encasement of the plant in a resinous "shell" serves to keep the plant in a state of dormancy until the break of the dry season.

Due to this increased production of secretory material young plants even of the most edible varieties are rarely touched by stock, in fact one may generalise and say they are inedible. It may be added that it appears probable that the exudate in the young plant is of different composition to that in the mature tree. For instance the bitter principle associated with the exudate is much more evident in the young than in the mature plant.



Annual *Trichinium* spp. appearing after rain on Mulga flats.

Further analysis and separation of the constituents of the resinous exudate is required before anything further can be said on this point.

The result of a feeding experiment with penned sheep on Boolardy Station regarding the relative edibility of the young and mature trees may be given here. The experiment was carried out to substantiate the general conclusion that the plant in its young stages was inedible to stock.

Small branches cut from a Mulga of some 4 feet in height were fed to sheep together with branches from a mature tree. Both young and old trees were of the same variety and were growing within a few yards of one another. Within an hour of feeding, all the branches from the mature tree had been stripped, whilst the young growth remained absolutely untouched. The branches were left in the pens with the idea that the sheep would perhaps reconsider the apparently inedible young growth when their hunger increased. Fifteen hours later, at the time coinciding with the early morning feed, the bundles remained untouched as on the night before, in spite of the fact that the sheep were ravenous for further feed. After two days the bundles of branches which still remained

untouched, were removed from the pens. The branches from the young Mulga were in the same condition as when placed in the pens some three days before. No attempt had been made by the sheep to eat them.

The position is therefore singularly fortunate for the plant in that the secretion primarily elaborated as a protection against adverse climatic conditions also acts as a barrier to the ravages of stock. This applies particularly to the plant under 4 feet in height. From 4-6 feet the tips of the branches may be nibbled by sheep but the tree sustains no great injury. As the tree grows the edibility increases, but even in trees of 10-12 feet the edibility is still low as shown by the way bullocks and camels leave these trees for those more mature.

It has been noted on occasions when immature trees have been cut that the sheep may eat the upper 2-3 feet but leave the lower branches entirely untouched. This seems to point to the fact that there is a fairly definite point at which active secretion by the trichomes is to some extent arrested.

W. A. Cannon (7) in his observations on desert plants in South Africa touches on this point, observing that as the plant matures the number of trichomes or secretory glands occurring on the leaves or phyllodia is reduced. It is possible that the transitional period may coincide with the time at which full development of the root system occurs.



Annual *Trichinium* spp. after rain on Mulga flats.

From the regeneration point of view the importance of the above fact is of the greatest magnitude. It means that during the period when the plant is most accessible and, one would think, most desirable as a stock feed, it is protected from grazing animals by the elaboration of a distasteful principle primarily produced to help it withstand periods of adverse climatic conditions. Without this protection in the young state the chances of regeneration of Mulga country in the stocked areas would be exceedingly small.

The time taken to reach maturity in the case of the Mulga is comparatively long, probably some 30-40 years depending largely on the nature of the seasons during the period of its growth. During favourable seasons its growth is rapid while periods of dormancy coinciding with dry seasons are only too frequent. The growth of the Mulga plant can best be described as spasmodic rather than slow. Immature trees of some 10 feet in height have been said to be 15 years old. Probably double that period is required for the tree to reach maturity, although, as before said, conditions of season and habitat may prolong or decrease this period.

Regeneration.

The almost entire absence of young growth within the Mulga country is a point stressed by many observers and has led to the conclusion that regeneration is practically non-existent. It is, however, not until the competition of the larger trees has been removed by cutting or depredation of drought that the young growth appears. The extensive lateral development of the root system of the Mulga which lies within a few inches of the surface precludes competition of the young plants.

The following table was compiled from information of a survey of an area where regeneration was taking place following the cutting out of the larger trees some twenty to thirty years ago. The table is designed to give the proportion of young growth to mature Mulgas.

TABLE II.

Traverse.	No. of Mulgas.		Total.	Percentage Young to Old Mulgas.
	< 10 ft.	> 10 ft.		
No. 1	117	28	145	% 417
No. 2	152	30	182	507
No. 3	150	69	219	232
No. 4	153	82	235	186
No. 5	132	89	221	148
No. 6	64	118	182	55
No. 7	73	135	208	54
No. 8	63	164	227	38
No. 9	69	172	241	40

Transect Nos. 1-3 pass through the fringe of the Mulga thicket which has been most heavily cut out, whilst Nos. 4-9 show the gradual passage into the virgin Mulga. The increasing number of young Mulgas in the former region demonstrates the permissive effect the removal of the mature trees has on regeneration.

It is in areas where the mature growth has been removed by cutting, as for instance in the mining areas of the Murchison (Cue, Meekatharra, Wiluna), that regeneration is most noticeable.

With regard to regeneration generally, it must be realised that rate of regrowth is naturally very variable within the several types of country. In the habitats most favourable to the growth of the Mulga regeneration is comparatively

fast, whereas on less favourable sites a long period of time may pass before the vegetation becomes re-established. Cutting on such marginal land if practised at all should be carried out with the greatest caution.

It is on such places that soil erosion may possibly become a menace. It is most unlikely, however, that conditions comparable to those prevailing in the arid portion of South Australia could possibly occur even in the most open country on the Murchison. The difference in soil type, the apparent absence of the rabbit in large numbers, (due to the character of the soil profile precluding burrowing) and the marked way in which regeneration of the *Acacia* shrubs takes place, are conditions very much in contrast to the position in South Australia as described by Ratcliffe (8). The Saltbush of all associations is the one most liable to extinction, but this does not occur except in cases of gross overstocking. The Saltbush occurs only in limited areas on the West Murchison.



Regeneration of Mulga 8-10 feet in height. Germinated about 1918.

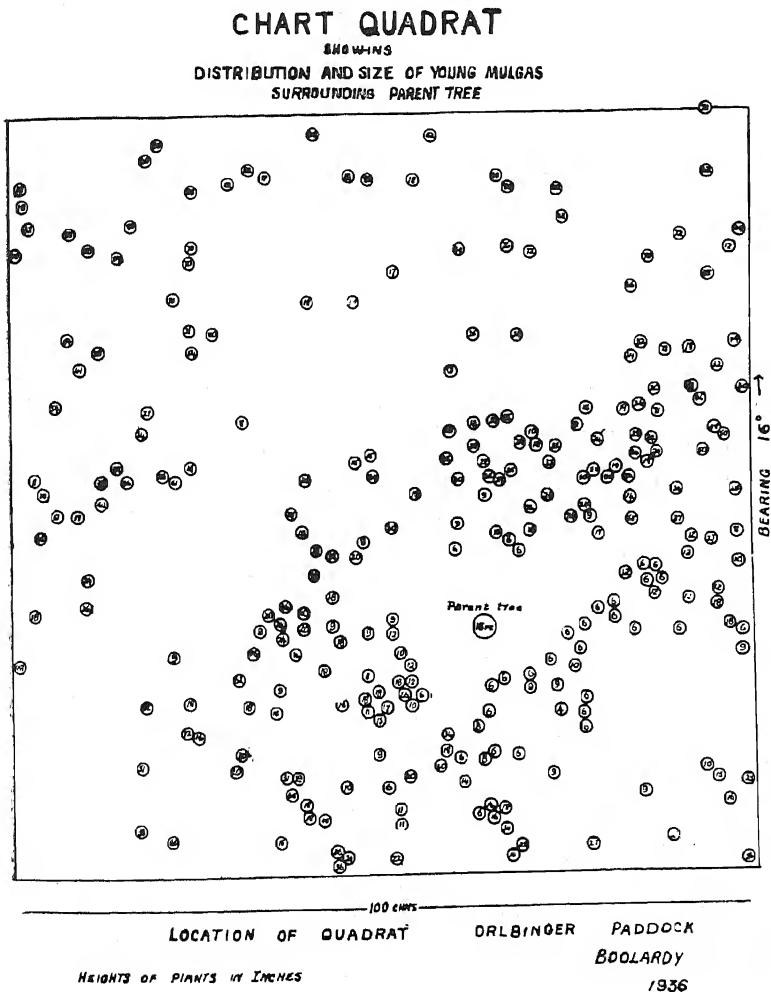
The paddocks surrounding the Boolardy homestead gave a good illustration of Mulga regeneration and provided a suitable area for study. In this area most of the mature trees had been cut out for requirements of the homestead such as posts and building material some 20-30 years ago. Today these paddocks are covered with young growth much denser than the original vegetation could have been. A point to be emphasised is that these paddocks have been carrying stock during this period and being in the vicinity of the shearing shed are used to some extent as holding paddocks.

The first impression gained in such a regenerating area is that the young growth is all more or less of standard heights. To illustrate this point reference may be made to the above area in which some time was spent. Here, for instance, there seemed to be a preponderance of young plants of about 4 feet high with fewer plants at 1-2 feet. One could also distinguish another group of 6 feet

in height and another at about 10 feet. Many intermediate sizes were of course present but the general impression was that the young Mulgas fell to a large extent into these size groups.

The conclusion to be drawn is that seasons favourable to germination and continued growth of the young plants occur only once in a number of years, probably something like once in five years.

To illustrate the extent to which the Mulga will regenerate, a quadrat was mapped out in a position on the margin of the regenerating Mulga thickets. Very few of the mature trees still remained in this area, the particular tree about which the quadrat centred being the only mature Mulga within a radius of some 2-3 chains.



The accompanying chart represents an area of 1 chain square and shows the position and heights in inches of the young plants surrounding the parent tree. It will be readily noticeable from the chart that the larger plants occur

furthest from the parent where competition is least. Such competition is restricted to water requirements, as light, as a factor limiting growth, could not be of any consequence in such a climate.

The smaller plants which are stunted in appearance occur closer to the parent. They appear to reach a certain stage of growth beyond which further development is impossible, due to the competition of the parent roots. Such plants probably linger and die making way for a further crop of seedlings, which however meet the same fate.

The competition in the virgin thickets of Mulga is such that survival of the young plants beyond the seedling stage is impossible. The graduation in sizes of the young Mulgas is not very well illustrated by the chart, being masked by the competitive effect of the parent plant.

The Mulga, like most of the Acacias, produces extremely hard seeds which are particularly resistant to climatic factors. The testas of the seed are thick and much soaking is required to penetrate them.

It appears then that it is only during periods when the country is flooded, (which is a periodic occurrence on the Murchison) that the seeds have the opportunity of germinating. Also the temperature range within which such seeds will germinate appears to be narrow. It will be realised then, that conditions for maximum germination occur only at infrequent periods.

The incidence of rains during the summer season appears to be most conducive to successful germination of seeds of the perennial vegetation. This fact is possibly the reason for the restriction of the true Mulga to the summer rainfall areas.

What has been said regarding the regeneration of the Mulga and the relation of the young plant to stocking is generally applicable to the majority of the vegetation.

It was noticed that the young Carara and Black Wattles were both generally disliked by stock, whilst the mature plants of these species are amongst the most edible plants of the Murchison. It may be taken as a general rule that the perennial Acacia vegetation is less edible in the young than in the mature stage.

The conclusion arrived at was that the effect of stocking on the regeneration of the vegetation is not as important as one might imagine. Unfavourable seasonal conditions appear to be by far the most important factor limiting regrowth.

5.—DROUGHT CONDITION.

The drought of 1935-36 will stand in the records of pastoral development as the most disastrous known, up till that time, in the Murchison district.

Losses of stock have been tragic and the extent of the deterioration of the country due to the dying out of the vegetation during this period has yet to be assessed.

The position during 1936 has been that ground feed was entirely absent. All low perennials such as Saltbushes, edible *Eremophila* species etc., have been defoliated and the larger shrubs have been eaten as high as the animals can reach. The

feed remaining consists of coarse inferior shrubs together with leaves and refuse that may fall from the larger shrubs and trees; all of which would be entirely inedible during even an ordinary dry year.

The almost denuded bushes with their tufts of foliage borne out of reach of the stock, give a singularly desolate appearance to the country. The only green within four to five feet of the ground consists of scattered Turpentine bushes (*Eremophila Fraseri*) and various inedible Acacia and Cassias. It seems incredible on viewing the country, that stock can still subsist on an area so destitute of fodder material. Only the remarkable constitution bred into the sheep by years of careful selection has saved the Murchison from complete loss of its sheep population.

During this year the stage appears to have been reached where due to the scarcity of feed, the time of feeding is insufficiently long for the sheep to fulfil its requirements.

According to Cory (9) in some work done on sheep and cattle under range conditions in Texas, about 13 per cent. of the sheep's time is spent in travelling, the balance he attributes to periods of resting, rumination and idling.

Under the abnormal conditions prevailing in the Murchison the time of travelling is quite inadequate for the sheep to obtain its feed requirements, with a consequent increased waste of energy and decreased period of resting and rumination. Despite the watering facilities available to the sheep, water is still a factor limiting the area over which the animal can travel in a day. Especially is this so in the hot months when the sheep visit water at least once a day. The section of the paddock in which a sheep grazes is also limited by the animal's refusal to drink from wells other than the one to which it is accustomed. Sheep appear particularly susceptible to changes in the character of the drinking water, and once they have become used to drinking water from a certain well it is particularly difficult to introduce them to another. The result is that the stock are restricted to the plant associations within normal travelling distance of the mill at which they are accustomed to drink. On the feed value and edibility of the constituent plants of these associations depends the welfare of the sheep.

During such dry periods it is noticeable that the condition of the stock at different wells varies considerably. While sheep watering at one mill are in fair condition the animals at the next mill may be dying of starvation.

The increased waste of energy in travelling, together with the low nutritive value and scarcity of feed are, one could say with some certainty, the causes of the drastic losses of stock during the last two years. At present one sheep to 100 acres is probably the maximum stocking capacity of a greater part of the country.

A factor which further decreases the amount of feed is the fact that certain shrubs, particularly Curara, respond to the drought condition by losing most of their leaves and in so doing reduce their transpiring surface. Considering the eminent position of the Curara (*Ac. tetragonophylla*) as a fodder, the importance of this phenomenon cannot be overlooked. The fallen leaves (phyllodia) do not seem to be eaten to any extent.

Another factor which assumes importance during drought periods is the competition between the kangaroo and the sheep for the remaining feed. The watering facilities which have made the increase in the sheep population possible have

also benefited the kangaroo with the result that, despite the thousands of these animals which are killed yearly, they must now assume far greater proportions than before the pastoral development of the country took place. The kangaroo has the advantage of being migratory in nature, following the thunderstorms and the resulting green picking. The sheep, confined by fences to a limited area must of necessity be content with the feed available in that area. The native animal has the further advantage of being able to reach higher up into the foliage of the shrubs.

Notwithstanding this, however, the sheep appear to be able to stand up to the conditions as well, if not better, than the kangaroo. During the drought it was noticeable that the mortality amongst the kangaroos was quite as great as amongst the sheep.

The most serious aspect regarding the kangaroo menace is that "spelling" of paddocks from sheep merely means the encouragement of the kangaroo. Until the kangaroo is controlled, any scheme of conservation of paddocks for drought feeding must of necessity be impracticable if not futile.

The fluctuation in the feed supply is nowhere so great as in the topfeed country where the bulk of the perennial vegetation is inaccessible to stock. In the Murchison where *Acacia* shrubs, which attain almost tree-like proportions, form almost the entire perennial growth, only a small proportion is available as feed. The low growing vegetation is mostly of an ephemeral nature appearing in abundance only during a good season. With the approach of the dry season this growth dries out and is blown away in the hot blast of winds. The stock are then forced on to the limited amount of topfeed accessible to them. In the *Spinifex* areas, to take a comparison, the bulk of the vegetation is at all times available to stock. We still have the lowering of the carrying capacity during the dry season but the fluctuation is nowhere as great as in the Murchison. For this reason the *Spinifex* is recognised to possess double the carrying capacity of the Mulga country.

Utilisation of the surplus feed from the good season and discreet use of the topfeeds in making them available to stock appear to be distinct possibilities in alleviating the poor feeding conditions prevailing in the Mulga areas during drought years.

In conclusion it may be remarked that the excellent quality of the wools produced in this region must in no small way be due to the particularly high nutritive value of the *Acacia* shrub and bushes. Every effort should be made therefore to protect and foster their growth at the same time making full use of their valuable feeding properties.

The productivity of the Murchison country for pastoral pursuits depends on the continued existence of the *Acacia* topfeeds and any action which may prove detrimental to their existence can only have the effect of seriously aggravating the drought problem.

6.—SUMMARY.

1. An account of the chief physical features of the Western Murchison is given together with a general account of vegetation types.
2. A description of a more detailed survey of a representative area on the Roderick River is included.

3. Observations on Boolardy Station with regard to sheep being fed on Mulga are described, and the theory of edibility being related to the amount and nature of the resinous exudate produced by these plants is advanced.

4. The chief problems of the area appear to arise from:

(a) The extreme fluctuation in production from year to year due to climatic variation.

(b) The difficulty of retaining breeding stock during periods of drought.

5. Possible solutions to these problems may lie in:

(a) The controlled exploitation of the resources of inaccessible topfeeds (Mulga) during drought periods.

(b) Conservation of the over-abundant ephemeral growth in the form of hay, etc.

7.—ACKNOWLEDGMENTS.

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Grateful acknowledgment is made to Professor J. E. Nichols who suggested and directed the research and gave valuable help throughout. Appreciation is also tended to Miss N. Burbidge for help in the identification of botanical specimens.

8.—REFERENCES.

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Wheat Variety Trials on Research Stations.

I. THOMAS, Superintendent of Wheat Farming.

L. W. SAMUEL, Cereal Research Officer.

A. J. MILLINGTON, Plant Geneticist.



Field Day at Wongan Hills Research Station, 1946—Inspecting the Wheat and Oat Variety Trials.

WHEAT Variety Trials conducted on the Research Stations served to test a number of new varieties against Beneubbin and Bungulla, the standard mid-season and early maturing varieties respectively, which between them were sown to over 55% of the 1946 acreage in Western Australia. As in previous years an endeavour was made to include the new rust resistant varieties released in other States, but shipping delays resulted in one of these, Celebration, arriving too late for planting. Also tested for the first time were six cross-breds from the Merredin and one from the Wongan Hills Research Station.

Seasonal Conditions.

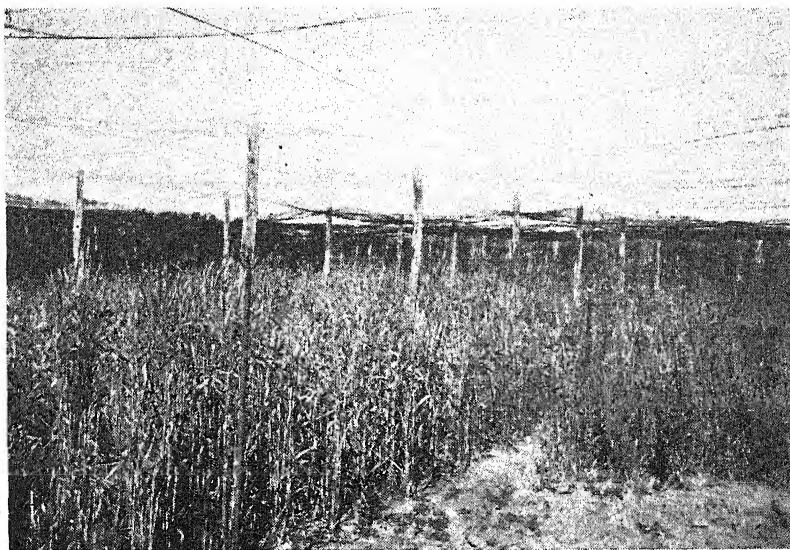
The season was characterised over most of the wheatbelt by above average winter rainfall with no useful rains after the beginning of September. At Salmon Gums no rain fell before mid-June but this was supplemented by above average September falls not recorded elsewhere. Details of the Research Station rainfalls are given in Table 1.

TABLE NO. 1.

Year.	Jan.	Feb.	Mar.	Apr.	Growing			Period	Rainfall			Nov.	Dec.	Annual
					May.	June.	July.	Aug.	Sept.	Oct.	Total.			Total.
Merredin, 1946	2	24	3	52	203	305	375	187	94	5	1,169	78	0	1,328
Average	45	57	98	88	137	192	179	154	81	74	818	40	60	1,206
Wongan Hills, 1946	0	33	21	201	244	444	447	197	18	2	1,352	106	0	1,713
Average	63	49	100	87	189	263	252	207	95	69	1,075	41	45	1,432
Chapman, 1946	4	24	16	102	160	597	852	229	27	3	1,868	193	12	2,219
Average	28	39	68	72	233	427	384	267	148	85	1,547	35	27	1,815
Avondale, 1946	3	0	3	86	348	786	665	182	15	1	1,997	99	14	1,954
Average	26	40	111	79	221	327	299	252	107	80	1,287	46	34	1,522
Salmon Gums, 1946	15	0	0	14	42	275	207	115	170	45	854	92	47	1,022
Average	91	71	149	92	130	149	142	152	90	111	774	88	84	1,348

The abnormally wet winter and the following very dry spring were not conducive to average yields in the most reliable wheat-growing areas but some of the drier and marginal districts experienced a satisfactory season.

The earlier plantings in the higher rainfall districts were mostly badly waterlogged in the winter, and subsequently severely attacked by the take-all complex of diseases. However, several crops in these districts sown on pea stubble gave satisfactory yields despite the adverse conditions.



Brush enclosures at the Merredin and Wongan Hills Research Station, where with the help of irrigation artificial rust epidemics are produced for testing new crossbreds.

Rust Resistance.

Widespread rust damage was experienced in South Australia during 1946 and, as with epidemics in this State (Cass Smith and Millington, 1944), the outbreak of the disease was preceded by heavy summer rains. The self sown crops, which germinated after these rains, on stubble land became heavily in-

fectured with rust and the disease spread during the winter to the adjacent autumn sown paddocks. (A. T. Pugsley, 1946). When at planting time nearby paddocks contain self-sown crops heavily infected with rust, the hazard of an epidemic of that disease during the season must be rated very high.

The losses from rust can best be minimised by having on hand substantial supplies of resistant varieties for planting in such seasons of high rust hazard.

No rust has occurred on crops in epidemic form in W.A. for four years, but in view of recent developments in the other States it is uncertain whether Eureka and its derivatives will continue to be resistant. In New South Wales and more recently in other States, a strain of rust has appeared which attacks the hitherto resistant variety Eureka. The Department of Agriculture therefore, seeks the co-operation of farmers in obtaining rusted wheat plants and as soon as the disease is observed specimen plants should be forwarded to the Government Plant Pathologist, Department of Agriculture, Perth.

The farming industry is deeply indebted to the New South Wales Department of Agriculture for its enterprise in collecting varieties from all parts of the world, and subjecting them to tests for rust resistance. From Kenya Colony varieties were obtained which are resistant to the new rust race as well as the old and their resistance has been incorporated in varieties suited to Australian conditions.

TABLE NO. 2.

Breeder.	Type of Resistance.			
	A. Eureka.	B. Kenya C6041.	C. Kenya C6042.	Mature D. Plant.
New South Wales Department of Agriculture ...	Eureka Frisco	...	Charter Yalta	Celebration
W.A. Department of Agriculture	M.78 M.79 M.80 M.81	M.70 M.71......	............	............
Sydney University ...	...	...	Gabo Kendee	Hofed Fedweb
Waite Institute ...	...	...	...	Warigo

Data published by Drs. Waterhouse and Watson for the Sydney University forms the basis of Table II. which classifies the type of resistance possessed by the rust resistant varieties now under cultivation in Australia or undergoing advanced trials. For very rust liable districts in W.A. it would be advisable to have on hand reserves of varieties possessing the B, C or D types of resistance rather than the A or Eureka type.

MERREDIN RESEARCH STATION, TABLE III.

Variety.	Flour Strength.				Yield.		
	Farinograph.		P.T.	D.G.	Yield.	Control, 1946.	Average. No. yrs. ().
	S.F.	W.A.					
<i>Early Planted Trial :</i>		%			Bus. lb.	%	%
Beneubbin (Control)...	8.2	64.7	65	13.4	22 5	100	100 (3)
Eureka	21.5	65.6	146	13.6	19 47	90	84 (3)
Kondut	15.7	64.0	134	12.4	18 24	83	73 (3)
Koorda	8.6	61.5	70	14.3	17 39	80	...
Difference for significance (P = .05) ...	...	...	...	...	2 21	12	...
<i>Late May Trial :</i>							
Bungulla (Control) ...	9.4	64.0	59	13.4	20 47	100	...
Charter	20.8	70.0	128	15.4	18 51	91	89 (3)
M.71	8.4	60.6	75	14.4	19 30	94	...
M.78	22.2	65.8	125	13.3	19 51	96	...
M.79	13.8	65.7	74	16.0	21 11	102	...
M.81	10.6	68.8	63	14.0	21 30	104	...
W.12	16.6	65.4	104	13.5	17 52	86	...
Difference for significance (P = .05) ...	...	...	...	...	1 39	8	...
<i>Late May-June Trial :</i>							
Bungulla (Control) ...	8.1	62.2	57	11.5	21 2	100	...
Charter	19.2	69.6	129	16.0	21 41	103	...
Gabo	15.9	73.4	88	14.0	19 44	94	...
Kendee	19.7	67.9	119	14.6	20 11	96	...
M.77	17.1	70.0	76	13.4	22 29	107	...
M.80	14.4	66.7	123	12.2	23 55	114	...
Difference for significance (P = .05) ...	...	...	...	...	1 10	6	...

S.F. = Strength figure.
W.A. = Water absorption.
P.T. = Pelshenke time in minutes.
D.G. = Percentage of dry gluten.

Flour Strength.

This year Table III giving the results from the Merredin Research Station includes data on the strength of the individual varieties and this makes it desirable to explain the significance of these tests. The baking quality of wheat or flour may be defined as the suitability of the flour for the required purpose and the strength of a wheat or flour is the fundamental property which governs its quality. Thus a weak flour may be more suitable than is a strong flour (and therefore of better baking quality) for cakes, home-baking, self-rising flour or certain types of biscuits.

In wheat breeding, tests are made of the strength of the varieties to determine their quality, i.e., to determine the purpose for which they are suitable and since the greater proportion of flour is used for breadmaking the results

of the tests are usually evaluated as for bread flours. There is no single test for strength which is entirely satisfactory so three different tests are used by the Department when sufficient wheat is available. These three tests are:

- (1) The Pelshenke time or wholemeal fermentation time test.
- (2) The Gluten test, and
- (3) The Farinograph strength figure.

For comparison of the data shown in Table III. it may be noted that the 1945-46 f.a.q. sample had a Pelshenke time of 33mins., a dry gluten content of 7.4% and a strength figure of 4.8 mins.

These tests and their relationship were described by Samuel (1938) but are briefly as follows:—

1. The Pelshenke test is applied to the wheat, which is ground to pass a 1 mm. sieve (25.4mm equals lin.) and 5 grams of the meal made into a doughball with the requisite distilled water containing 0.25 gram of yeast. This doughball is immediately immersed in water maintained at 32°C. In 10-15 mins. the gas produced by the yeast fermentation inflates the doughball so that it floats. Further fermentation causes further expansion of the ball until finally it disintegrates. The Pelshenke time is the time in minutes from the immersion of the doughball in water to the first disintegration. The longer the time the stronger the wheat.

2. The gluten content is determined on the flour by making a doughball of 10 g. of flour with the requisite water, allowing the ball to stand one hour in water, and then kneading it in running water. This washes away the starch as a milky liquid and leaves the gluten as a coherent, yellow to yellow-brown soft rubbery mass which is dried and weighed. The greater the gluten content the stronger the flour but the strength is also dependent on the type of gluten in the flour.

3. The Farinograph operates on the flour and is essentially a self recording dough mixer which records the electrical power necessary to mix a dough of standard consistency and records the change in power with continued mixing of the dough.

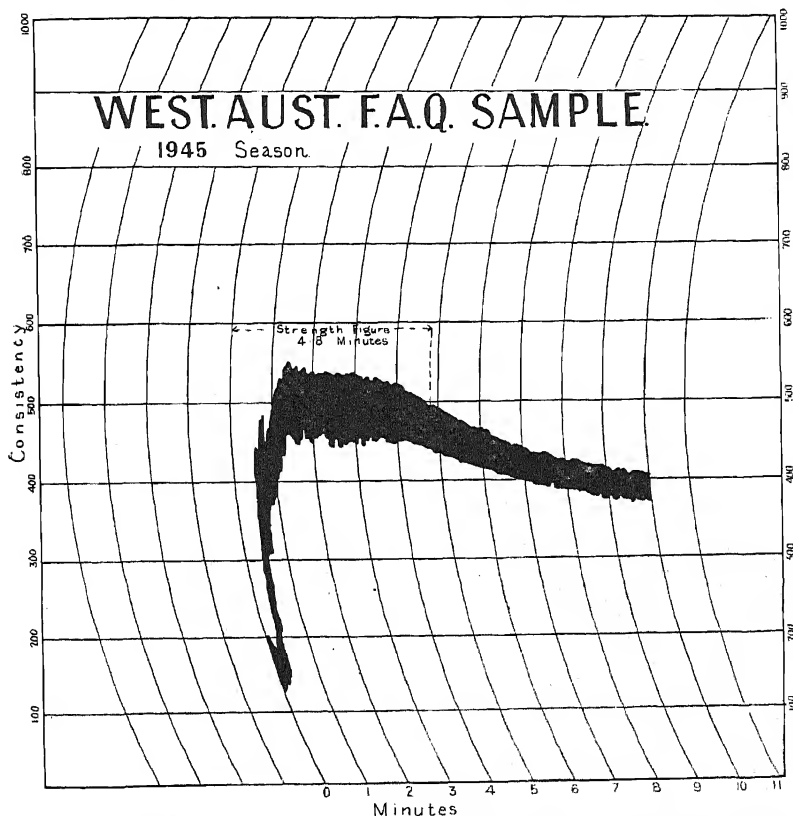
Initially the graph of the power required rises to a maximum as the flour and water are mixed to a dough, remains at a maximum for a period of time which varies with the strength of the flour, and then decreases. The farinograph strength figure is the time in minutes from the beginning of mixing until the top of the grain falls below the level of the mid-point of the graph at maximum consistency. The longer the time, the higher the strength figure and the stronger the flour.

The water absorption, while not a valid measure of strength, is important, as the greater the water absorption the greater the yield of bread from a given quantity of flour.

In evaluating the results of the tests of the Variety Trial at the Merredin Research Station for suitability for bread-making it may be noted that good bread can be made from flours of widely different strengths, provided the bread-making technique is altered to suit the flour but, in general, the bread-making technique is relatively fixed and for a flour to give good bread its strength must be suitable for the practice of the baker. On the world's market and in particular, on the English market, West Australian f.a.q. is classified as too weak to make satisfactory bread. Thus when using West Australian wheat the overseas miller needs to include in his grist a wheat sufficiently strong to raise the resultant flour to the required strength. This imposes two limits on the amount

of West Australian wheat which can be so used, firstly by the availability of the strong wheats and secondly by the price, for normally the strong wheats command a higher price.

To avoid this limitation, a primary object of the wheat breeding programme in this State is to raise the strength of the West Australian f.a.q. wheat to the level that it does not need assistance from, or building up by, a strong wheat. This strength is referred to as a "filler" wheat since after the miller has adjusted the proportions of strong and weak wheats in his blend he can use an unlimited amount of filler wheat without materially altering the strength of the resultant flour.



It is considered that the strength tests of these wheats from the Merredin Research Station show that the popular varieties are capable of filler strength under suitable soil and climatic conditions. The areas proposed to be sown to Beneubbin and Bungulla in the 1946-47 season were some 35% and 21% respectively of the total area to be sown.

Thus our present varieties have bred into them sufficient strength for filler wheats if growth conditions permit them to develop their inherent strength. This directs attention to the growth conditions as distinct from the continuation of the breeding programme to evolve varieties which will be of filler strength under present growing conditions of soil fertility and climate.

Strength and Environment.

The variability of the strength of an individual variety of wheat is illustrated in Table IV. showing the results of the strength tests of three varieties grown at five Research Stations in the 1945 season.

TABLE IV.

VARIATION IN FLOUR STRENGTH WITH SOIL AND CLIMATIC CONDITIONS.

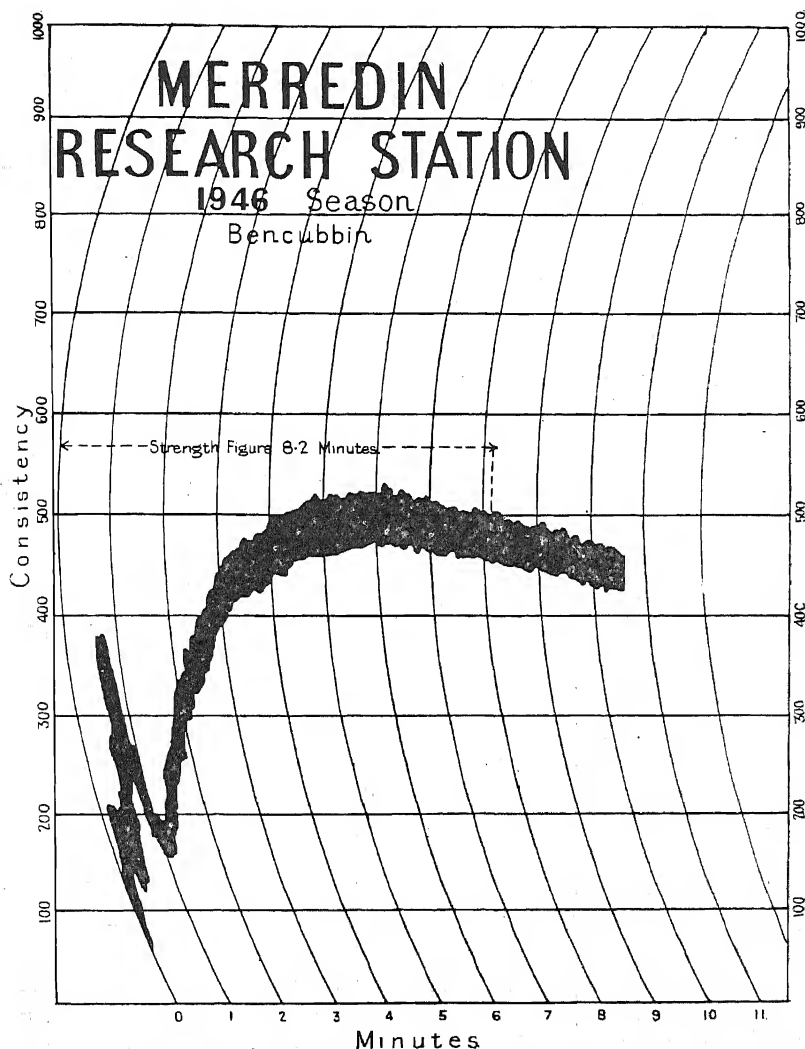
Data from various Research Stations, 1945-46 season.

Variety and Source.	Beneubbin.			Eureka.			Kondut.		
<i>Avondale.</i>									
Strength figure (mins.) ...	2.6	...	...	2.6	...	...	2.0	...	...
Pelshenke time (mins.) ...	...	37	...	...	32	...	...	30	...
Dry gluten % ...	...	...	5.0	...	...	5.5	...	...	5.0
Specific protein strength from strength figure ...	0.5	...	...	0.5	...	...	0.4	...	...
Pelshenke time ...	...	7.4	...	...	5.8	...	...	6.0	...
<i>Chapman :</i>									
Strength figure (mins.) ...	2.5	...	...	2.7	...	...	2.5	...	...
Pelshenke time (mins.) ...	...	44	...	...	45	...	...	44	...
Dry gluten % ...	...	...	5.4	...	...	6.4	...	...	6.2
Specific protein strength from strength figure ...	0.5	...	...	0.4	...	...	0.4	...	...
Pelshenke time ...	...	8.1	...	...	7.0	...	...	7.1	...
<i>Merredin :</i>									
Strength figure (mins.) ...	9.4	...	...	13.4	...	...	14.3	...	...
Pelshenke time (mins.) ...	...	46	...	...	85	...	...	87	...
Dry gluten % ...	...	...	9.3	...	...	10.2	...	...	13.2
Specific protein strength from strength figure ...	1.0	...	...	1.3	...	...	1.1	...	...
Pelshenke time ...	...	4.9	...	...	8.3	...	...	6.6	...
<i>Salmon Gums :</i>									
Strength figure (mins.) ...	3.3	...	...	6.4	...	...	6.2	...	...
Pelshenke time (mins.) ...	...	39	...	...	61	...	...	61	...
Dry gluten % ...	...	...	7.2	...	...	8.4	...	...	8.3
Specific protein strength from strength figure ...	0.5	...	...	0.8	...	...	0.7	...	...
Pelshenke time ...	...	5.4	...	...	7.3	...	...	7.3	...
<i>Wongan Hills :</i>									
Strength figure (mins.) ...	2.4	...	...	4.7	...	...	2.5	...	...
Pelshenke time ...	...	36	...	...	37	...	...	34	...
Dry gluten % ...	...	...	5.4	...	...	7.8	...	...	6.2
Specific protein strength from strength figure ...	0.4	...	...	0.6	...	...	0.4	...	...
Pelshenke time ...	...	6.7	...	...	4.7	...	...	5.5	...

In Table IV. two new factors for strength have been calculated. These may be defined as (a) the strength figure per per cent. of dry gluten and (b) the Pelshenke time per per cent. of dry gluten and are obtained by dividing the strength figure and Pelshenke time respectively by the percentage of dry gluten. Since the specific protein strength for a variety does not vary as markedly as either figure or the Pelshenke time the main reason for the difference in strength of the same variety from different Research Stations is the difference in gluten content. However, since the specific protein strength does vary, the evidence from this and other data is that the strength of the gluten of an individual variety does vary with growth conditions.

In a previous issue of this Journal (Samuel, 1945) data was published to show the marked effect which crop rotation can have on flour strength as well as on yield. The inclusion of a legume in the rotation, particularly on the lighter

soil types usually materially improves both flour strength and yield. The increments will be smaller after very wet winters such as those of 1945 and 1946, particularly if the crop is sown on fallow. Any substantial increase in the flour strength of the W.A. f.a.q. will be dependent not only on the cultivation of inherently stronger flour varieties but also on the more extensive use of legumes. That the latter is likely is shown by the increased areas of First Early (Dwalganup) sub-clover on the lighter soils of the 14-18" rainfall belt as evidenced by the planting during the war years in one Midlands district alone of 100,000 acres to this legume.



New Varieties.

The four new varieties tested were Frisco, Yalta, Gabo and Kendee. All are resistant to the strains of rust collected so far in Western Australia, but Frisco is susceptible to the new type which is present in the Eastern States.

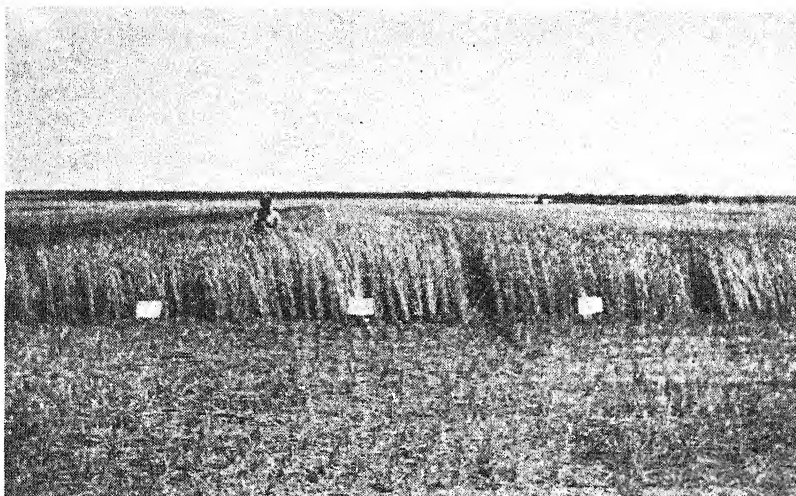
WHEAT VARIETY TRIALS—TABLE V.

Variety.	Avondale.			Chapman.			Salmon Gums.			Wongan Hills.		
	Yield.	Percentage of Control.		Yield.	Percentage of Control.		Yield.	Percentage of Control.		Yield.	Percentage of Control.	
		1946.	Average.		1946.	Average.		1946.	Average.		1946.	Average.
<i>Early May Trial:</i>	Bus. lb.			Bus. lb.			Bus. lb.			Bus. lb.		
Bencubbin ...	10 54	100	100 (3)	5 26	100	100 (3)	14 56	100	100 (3)	5 49	100	100 (2)
Eureka ...	10 30	97	89 (3)	4 6	75	76 (3)	12 0	80	83 (3)	5 57	102	89 (2)
Kondut ...	11 36	107	94 (3)	5 2	93	90 (3)	12 35	84	83 (3)	5 17	91	82 (2)
Koordla ...	...	...	...	4 58	91	...	...	...	...	4 39	79	...
Frisco ...	...	...	...	5 31	101	...	...	...	...	...	...	...
Yalta ...	...	...	...	6 22	117	...	13 14	89	...	...	...	...
M.75 ...	10 0	91	...	...	...	...	...	...	...	...	...	...
Difference for significance ...	0 51	8	...	0 32	10	...	1 43	11	...	0 34	10	...
<i>Late May Trial:</i>												
Bungulla ...	16 42	100	100 (3)	9 12	100	100 (3)	14 24	100	100 (3)	17 38	100	100 (3)
Charter ...	15 36	93	88 (2)	6 51	75	91 (3)	15 6	104	94 (2)	15 20	87	77 (3)
M.71 ...	...	...	...	8 42	94	...	...	...	...	...	...	...
M.77 ...	18 36	111	...	9 14	100	...	14 50	103	...	16 58	96	...
M.78 ...	...	...	...	8 46	95	...	...	...	...	...	...	...
M.79 ...	...	...	...	8 22	91	...	15 6	104	...	17 52	101	...
M.80 ...	16 42	100	...	8 19	90	...	16 16	113	...	16 7	91	...
M.81 ...	17 36	105	...	...	...	...	...	...	...	19 17	106	...
Koordla ...	...	...	...	...	...	...	13 58	97	91 (3)	...	...	...
Difference for significance ...	1 55	11	...	1 3	12	...	0 55	6	...	1 28	9	...

Yalta and Frisco were bred by the New South Wales Department of Agriculture, whilst Gabo and Kendee were released by the Sydney University. Sufficient seed of these varieties was available for trials at one Station only, but they will be more widely tested during the coming season. In general, as will be seen from the yields given in Table V., they promise to be very useful varieties.

Difference for Significance.

Two adjacent plots sown on the one day to the same variety and with identical fertiliser treatment will not give equal yields because of uncontrollable factors, such as soil variability. It is possible, however, to calculate in bushels per acre for any correctly designed experiment, the allowance which must be made for the uncontrollable factors and this figure appears in the line "Difference for significance. $P = .05$."



Portion of a Wheat Variety Trial—Merredin Research Station, 1946. Each plot is one-eighth of an acre and is replicated five times in Randomised Blocks.

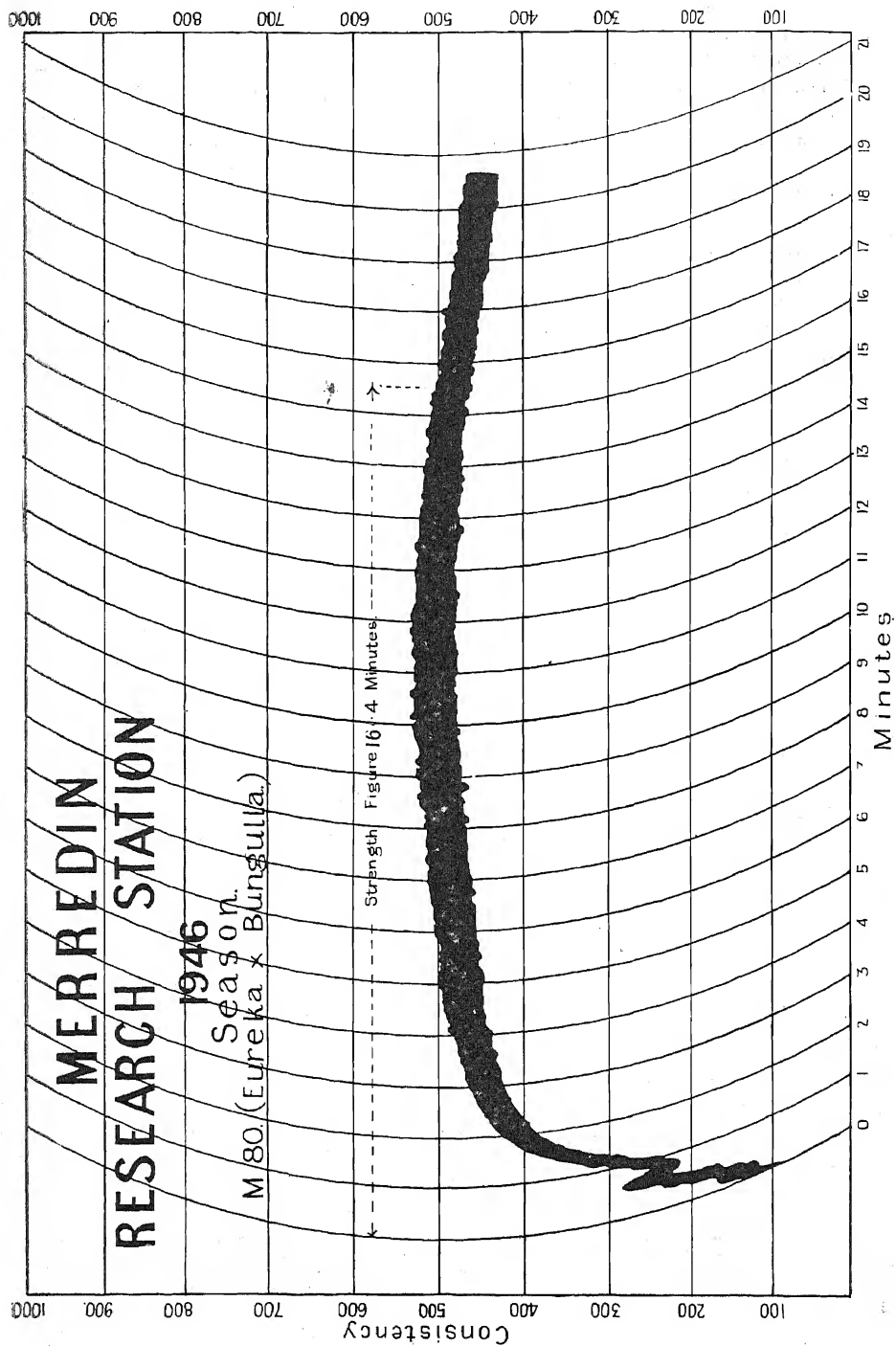
If one variety yields 10 bushels and another 15, i.e. by a margin of 5 bushels, and the "difference for Significance" is 3 bushels, then the higher yielding one significantly outyielded the other. If the margin had been two instead of five bushels, the difference would not be significant. It would be assumed that the varieties are equal in yielding ability and that the difference in yield, 2 bus./acre was due to soil variability and similar uncontrollable sources of variation.

New Crossbreds.

Crossbreds produced at the Merredin Research Station carry the prefix "M" and those from Wongan Hills "W".

Sword x Kenya C6041. M.71. An early maturing variety tested for the first time. M.71 yielded fairly well and will be included in further trials. It is resistant to the Eureka attacking strain of rust.

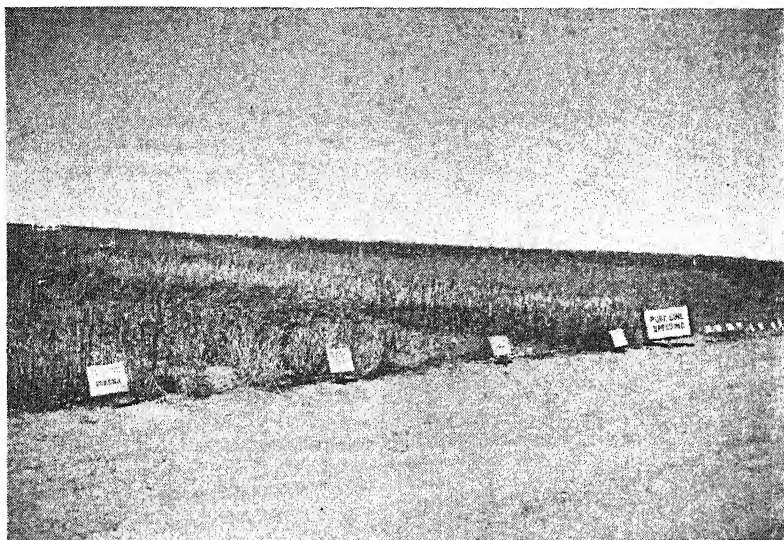
Marathon x Totadgin. M.75. This variety showed promise for grazing and recovery, but the grain yields were low.



Eureka x Bencubbin. M.77 and M.78. These early maturing varieties are being retained for further trial. At Merredin M.77 usually yields flour which approaches premium strength whilst M.78 is even stronger. Both have satisfactory straw strength and possess the Eureka type of rust resistance.

Eureka x Bungulla. M.79, M.80 and M.81. Of these M.80 will be retained for further trial, as in three of five tests it significantly outyielded Bungulla. The straw strength is very good for an early maturing variety and it usually yields flour of approaching premium strength.

Carrabin x Waratah. W.12. The yield obtained from this variety was not up to expectations.



The initial step in the production of pedigree seed is the maintenance of a "pure line," which serves to keep varieties breeding true for the varietal characteristics.

Varieties Tested Previously.

Bencubbin. Although this remains the most extensively grown variety in W.A., with 35% of the total acreage, in the drier districts many farmers are replacing it with Bungulla. Bencubbin remains the most prolific mid-season variety for the W.A. wheatbelt.

Bungulla. The late opening rains and dry spring conditions of the 1945 and 1946 seasons have served to emphasise the suitability of Bungulla for much of the W.A. wheatbelt. It is used extensively for planting ploughed up pasture land and was sown over 21% of the 1946 acreage, making it the second most popular variety in the State. Bungulla often tends to lodge if sown before the third or fourth week in May.

Eureka. The yields obtained from Eureka have been disappointing on the whole. It will probably be replaced at an early date by a variety such as Yalta, resistant to the new rust strain, to which Eureka and its derivatives are susceptible.

Kondut. This variety yielded well at Avondale during 1946, but in general the returns have been below those of Bencubbin. Kondut has strong straw and is recommended for first plantings on light land when the season opens early.

Koorda. This early maturing variety has yielded best on light soils where its strong straw is advantageous.

Charter. Bred by the New South Wales Dept. of Agriculture, Charter yielded relatively better in 1946 than in the previous year. It often produces flour of premium strength and the straw is fairly satisfactory. The maturity is early. Since it is resistant to the Eureka attacking strain of rust, Charter is recommended for planting in the very rust liable districts.

ACKNOWLEDGMENTS.

The authors would like to express their thanks to the staff of the Research Stations for their assistance in conducting the above trials:—

Avondale Research Station	Mr. W. A. Human.
Chapman " "	Mr. W. Coxon.
Merredin " "	Mr. F. Gishubl and E. Langfield.
Salmon Gums " "	Mr. J. Tudor.
Wongan Hills " "	Mr. D. R. Bateman.

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Codlin Moth in Western Australia.

By C. F. H. JENKINS, Government Entomologist.

Areas Affected.

IN March, 1947, when infested apples were discovered in a backyard orchard at Collie, was recorded the fourteenth outbreak of Codlin Moth in Western Australia. The pest has never become firmly established in this State but since 1903 fourteen separate outbreaks have occurred, which may be tabulated as follows:—

Albany	..	1903-1904	Collie	..	1925-29
Perth, 4 outbreaks between 1904 and 1913			(Most severe outbreak yet recorded)		
Katanning	..	1913-14	Narrogin	..	1926-27
Bridgetown	..	1915-16	Collie	..	1934-37
Caversham	..	1918-19	Mumballup	..	1937-39
North Dandalup	..	1924-25	Collie	..	1947

With the exception of the Mumballup outbreak which is believed to have been an escape from the Collie area adjacent all infestations have undoubtedly been due to separate introductions from other States.

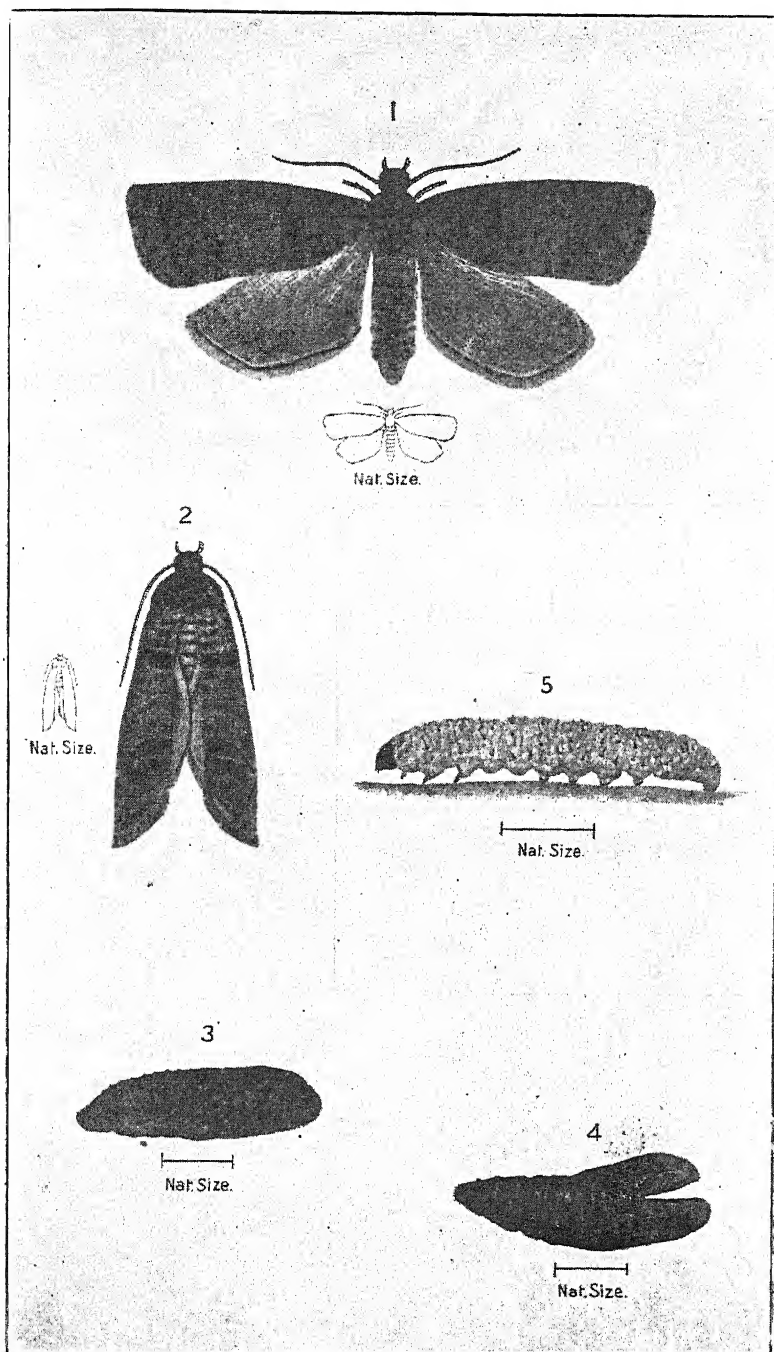


PLATE I.
The Codlin Moth.

Fig. 1—Moth with wings spread. Fig. 2—Moth at rest.
Fig. 3—Pupa. Fig. 4—Pupa case after moth has emerged.
Fig. 5—Caterpillar.

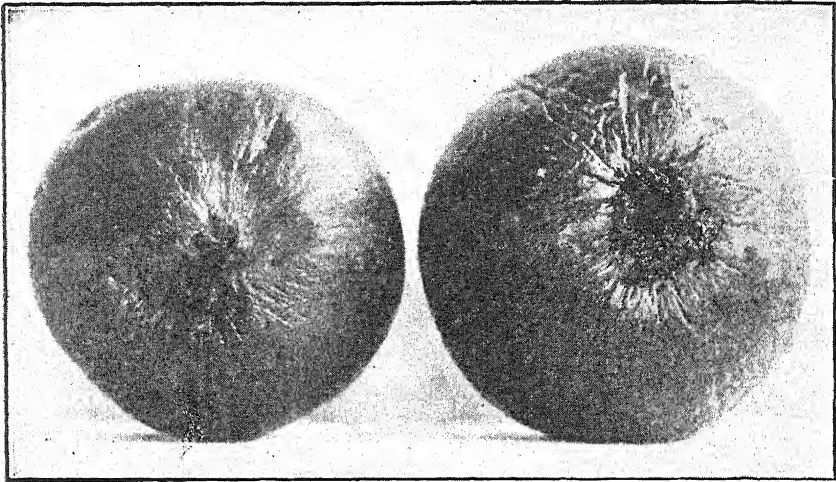


PLATE II.

Apples showing typical castings of Codlin larvae.

Suitability of Western Australia for Codlin Moth Establishment.

Western Australia is probably the only extensive apple growing area in the world in which the Codlin Moth is not established and strict quarantine regulations prohibiting the introduction of pome fruits (apples, pears, etc.) were early introduced to protect local fruit growers. The long list of outbreaks demonstrates that no system of quarantine is perfect and shows that constant vigilance is necessary on the part of growers. The fact that thirteen outbreaks have been successfully eradicated, however, has given rise to the belief in some quarters that this State is unsuitable for the establishment of the pest and it has been suggested that certain outbreaks have been recrudescences of earlier infestations. The severity of the first Collie outbreak clearly demonstrated the ability of the pest to thrive under local conditions and the fact that from 5 to 10 years have lapsed between the Collie outbreaks shows the impossibility of a pest such as Codlin Moth surviving unperceived during the intervening periods.

Methods of Introduction.

In no instance has the exact cause of any particular outbreak been traced but it is not difficult to suggest several means by which Codlin Moth could reach the State. During the recent war years, parcels forwarded from the Eastern States to troops stationed in Western Australia were found on several occasions to contain "Codlin" infested apples. With the improvement of air, rail and road transport the opportunity for ignorant or indifferent travellers to introduce infested fruits is ever increasing and is a constant menace. There are, however, other means by which "Codlin" caterpillars may enter the State. On leaving the fruit the caterpillars hide under any litter or bark to spin their silken cocoons and often choose a fruit or packing case for this purpose.

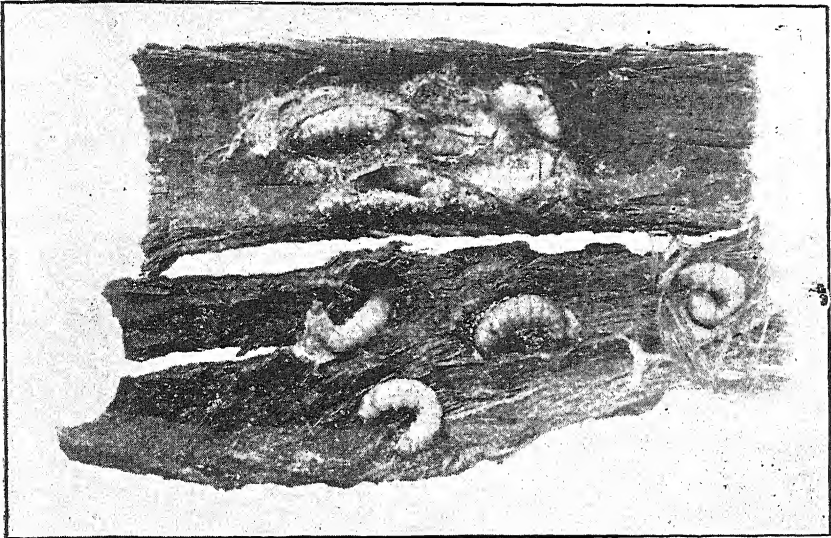


PLATE III.

Hibernating caterpillars of Codlin Moth taken from under bark during early winter.

Apples reaching Eastern States jam and sauce factories would contain a certain number of "Codlin" grubs and there is always the danger that some grubs may spin in packing cases or other merchandise to be later carried further afield. The fact that most local outbreaks have occurred either at ports or busy industrial centres supports this contention.

It may be asked why several outbreaks have occurred at Collie in comparatively recent years while none have been reported in Perth since 1913. This is easily explained by the fact that at one time, apple and pear trees were not uncommon within the city limits and Codlin Moths flying in the metropolitan area would have little difficulty in finding suitable food plants. This is not the case at present, however, whereas in the Collie area there is a profusion of fruit trees including apples and pears in almost every backyard offering every facility to caterpillars or moths transported in the district.

Co-operation Between Growers and Department of Agriculture.

The successful eradication of previous Codlin Moth outbreaks has been greatly furthered by growers drawing attention to the presence of the pest. The present outbreak may have gone for some time unperceived on account of its restricted nature had not specimens been forwarded to the Department by Mrs. Partridge of Forrest Street, Collie. The importance of forwarding for identification specimens of any strange insect causing damage cannot be over emphasised. If they are of no importance, no harm has been done, whereas if they are of a serious nature, the sooner they are detected the more likelihood there is of their being controlled.

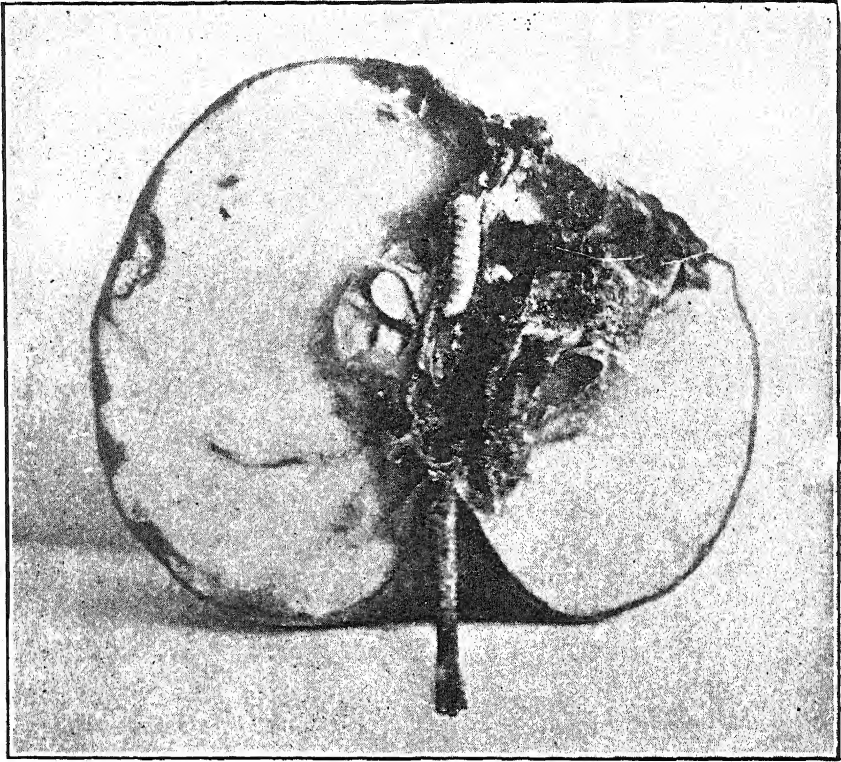


PLATE IV.

Cut apple showing typical work of caterpillars. (Note the pips have been consumed.)

How to Recognise Codlin Moth.

The illustrations accompanying this article will indicate the type of injury caused by the "Codlin" caterpillar. The "grub" is pinkish in colour and slightly under $\frac{3}{4}$ in. in length. There are several other caterpillars with which it may be easily confused however, and growers are advised to immediately forward specimens to the Department of Agriculture should anything of a suspicious nature be encountered.

Contagious Ophthalmia (Pinkeye) of Sheep.

C. R. Toop, Assistant Chief Veterinary Surgeon.

CONTAGIOUS ophthalmia better known to the sheep owner as "pinkeye" is a common disease of sheep particularly during the summer months. It is known to occur in the majority of countries where sheep are kept and, in Australia, is prevalent throughout the sheep raising areas.

The disease is highly contagious and may spread rapidly through the flock. It is caused by a microbe known as *Rickettsia conjunctivae* which is always present in the discharge from the eyes of affected animals.

The infection is believed to be spread by the agency of flies and the fact that outbreaks of the disease occur principally during the summer months lends support to this view.



Eye of sheep affected by ophthalmia. The eyelashes are gummed together with discharge and the cornea is affected by opacity. (After Edgar.)

The symptoms shown by affected sheep consist of a watery discharge from the eyes accompanied by inflammation, reddening and swelling of the eyelids. In a smaller proportion of cases there is opacity and ulceration of the cornea (transparent portion of the eye) together with a discharge of pus and partial or complete blindness.

Although the disease is not considered to be of serious economic importance it may nevertheless become a troublesome condition amongst travelling sheep particularly in the pastoral areas, whilst in farmers' flocks loss of condition and, in some cases, mortality may occur through the inability of sheep affected by blindness to obtain food and water.

After recovery has occurred sheep may continue to harbour the organisms in their eyes for several months during which time they remain carriers of infection and, although apparently healthy, are able to transmit the disease to other animals with which they are in contact. Recovery from the disease, moreover, does not result in the development of a lasting immunity and, when this is lost, the sheep again becomes susceptible and may suffer a further attack upon exposure to infection.

The recurrent outbreaks of contagious ophthalmia which may take place in a self-contained flock may be explained by the presence of these carriers of infection, the relatively short duration of immunity following an attack of the disease, and the fact that each successive drop of lambs adds to the flock a large number of highly susceptible animals.

The treatment of mild cases of the disease is not advised. Cases of this type predominate in the average outbreak and may be expected to recover spontaneously within a fortnight of the onset of symptoms. The treatment of such cases has no influence upon the rapidity of recovery. Severe cases showing evidence of blindness, however, should be removed from the flock for treatment and transferred to a hospital paddock or shearing shed where shade is available and there is easy access to food and water. The daily application of a 10 per cent. solution of zinc sulphate as an eye lotion is recommended for the treatment of these cases.

No effective method of prevention is known. The practice that is sometimes adopted of treating the whole of the flock in order to check the spread of the disease cannot be recommended. On the contrary by bringing the sheep into closer contact with one another it may favour the spread of infection and, since eye lotions cannot be relied upon to remove the organisms from the eyes of infected sheep, it cannot serve a useful purpose. Better results will be obtained by leaving the flock undisturbed, removing severe cases for treatment as they occur.

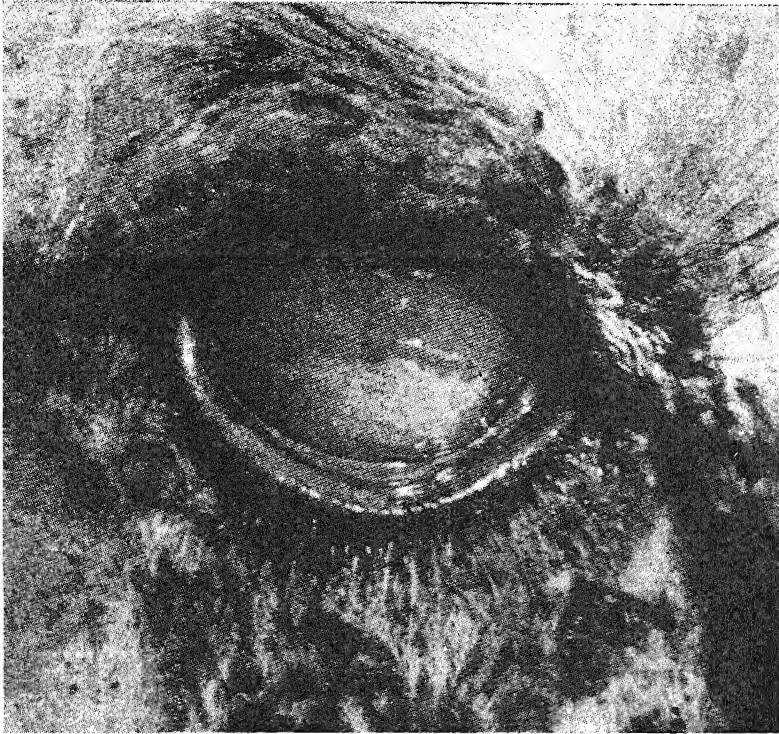
CAUSE.

The disease is caused by a microbe known as *Rickettsia conjunctivae*. These organisms are always present in the eye discharges of affected sheep and the disease may readily be transmitted from animal to animal when discharge taken from the eye of an affected sheep is placed in the eye of a healthy sheep.

Under field conditions the infection is believed to be spread by flies and the fact that the disease rarely occurs during the winter months and that outbreaks are frequent during summer and autumn when flies are prevalent supports this view. Moreover, when diseased and healthy sheep are held in adjacent pens in which direct contact cannot occur it has been observed that the disease has spread to the healthy animals, providing further evidence of the part played by flies in the transmission of infection. In the same manner infection may spread through fences from one property to another.

The infective agent does not survive very long apart from the sheep particularly upon drying of the eye discharges and it is, therefore, unlikely that sheep would become infected from trucks or yards previously occupied by diseased animals.

The view held by some sheep-owners that the disease is caused by dust or foreign bodies such as grass seeds is without foundation. It may also be mentioned that contagious ophthalmia of sheep is a highly specific disease which cannot be transmitted to other animals. The disease of cattle in which the symptoms are similar is caused by an entirely different type of organism.



A more advanced case. The cornea is opaque and ulcerated and there is an accumulation of dried discharge below the eye. (After Edgar.)

SYMPTOMS.

Sheep of all ages and breeds are susceptible to the disease. Both eyes invariably become affected but in some cases one eye may show evidence of infection a few days earlier than the other.

In the early stages of the disease there is inflammation and reddening of the conjunctivae (the membranes which line the eyelids and cover the front portion of the eyeball) with congestion of the blood vessels and swelling of the eyelids. This is accompanied by a profuse watery discharge from the eyes and discomfort upon exposure to bright light.

After a day or two the cornea (clear front portion of eye) commences to show evidence of opacity which first appears at the margin and may later extend towards the centre. The watery exudate is now replaced by a discharge

of pus which issues from the corner of the eye and gums the eyelashes together. The opacity of the cornea is usually only partial and though the sight may be impaired it is not seriously affected. In a smaller proportion of cases, however, the whole of the cornea becomes involved by opacity presenting a white milky appearance. The sheep in consequence becomes completely blind and unless given special attention may die through lack of feed and water. Ulceration of the cornea occurs in some of the more severe cases.

In the majority of sheep which become affected the disease occurs in a mild form, the opacity does not extend far beyond the margins of the cornea and complete recovery occurs within 10-14 days from the onset of the symptoms. In severe cases, however, the disease may persist for as long as six weeks and the animal may remain blind for a month during this period. It has been observed that the eye of the sheep has remarkable powers of recovery and that even when the cornea has become opaque and deeply ulcerated healing will occur leaving little or no blemish.

CARRIERS.

After the symptoms have subsided and recovery has occurred the casual organisms may persist in the eyes for several months. Investigations have shown that in about half of the sheep which have suffered from an attack of the disease the organisms are still present in the eyes 100 days after contracting the infection. One case in which a sheep remained infective for 250 days has been recorded.

Such sheep remain carriers of the disease and while showing no symptoms themselves they are able to transmit infection to other sheep with which they are in contact. The presence of these carriers will explain why recurrent outbreaks of the disease may take place in a closed or self-contained flock without the introduction of infected sheep from an outside source. Under such circumstances isolated cases may continue to occur in the flock passing unnoticed until conditions favouring the spread of infection such as droving or yarding for shearing or crutching during a period when flies are prevalent precipitate a severe outbreak. It also explains why sheep which are apparently healthy at the time of purchase may subsequently develop the disease.

IMMUNITY.

Recovery from the disease does not result in the development of a lasting immunity. Investigations have shown that recovered animals are resistant to re-infection for a period of about three months following upon which the immunity gradually wanes. More than 50 per cent. of recovered sheep, however, remain resistant for a year. When this resistance is lost the sheep again become susceptible and may suffer a further attack of the disease if exposed to infection.

When the relatively short duration of the immunity is considered together with the presence of carriers in the flock the periodical occurrence of fresh outbreaks of the disease will readily be understood. Moreover each fresh drop of lambs will result in the addition of a large number of highly susceptible animals to the flock thus increasing the chance of further outbreaks occurring.

TREATMENT.

Mild cases of the disease recover spontaneously and do not require treatment. This type of case predominates in the majority of outbreaks of contagious ophthalmia and observations have shown that recovery commences on the third or fourth day and is complete about seven days thereafter. It has been shown that the treatment of mild cases does not increase the rapidity of recovery. In experiments in which one eye was treated with 10 per cent. Zinc sulphate solution and the other left untreated as a control it was found that the untreated eye recovered just as rapidly as the treated one.

Severe cases showing opacity of the cornea, ulceration and blindness, however, require special attention, otherwise they may suffer serious loss of condition or death may result from starvation or thirst. Such sheep should be removed from the flock and transferred to a small hospital paddock where there is good shade and easy access to feed and water or, better still, they may be placed in the shearing shed where there is complete shade and hand-feeding may be practised.

For the treatment of these cases a 10 per cent. solution of Zinc sulphate is recommended, a few drops of which should be placed in the affected eyes daily until recovery has occurred. This lotion may be prepared by dissolving two ounces of Zinc sulphate crystals in a pint of water and may be applied with some convenient type of eye-dropper after separating the lids with the thumb and forefinger. A small oil-can will be found very useful for this purpose. Prior to treatment it may be necessary to clip the wool away from around the eyes and to remove any foreign bodies such as grass seeds, which may be present, with blunt forceps.

From the foregoing it will be obvious that there is no effective means of preventing the disease.

Since eye lotions cannot be relied upon to destroy the organisms which are present in the eyes of infected sheep, the practice which is sometimes adopted by sheep-owners of treating all members of the flock in an endeavour to check the spread of infection cannot be recommended. Indeed since this procedure by bringing the sheep into closer contact with one another favours the spread of infection it is likely to cause more harm than good.

It is far better to allow the flock to remain undisturbed making a daily inspection for the detection of badly affected or blind animals which should be transferred to a hospital paddock or the shearing shed for treatment.

Precautions should, however, be taken to prevent the introduction of the disease into a clean flock and a careful examination for the detection of ophthalmia should always be made whenever the purchase of additional sheep becomes necessary.

While the absence of symptoms does not necessarily indicate freedom from infection, since carriers may be present, a careful inspection prior to purchase may succeed in preventing the introduction of the disease into the flock and it is a precaution which should never be neglected.

Protein—From Where ?

L. C. SNOOK, Animal Nutrition Officer.

THE wide-spread lack of protein-rich foods is of considerable concern to those farmers who have to keep milch cows in production, feed laying hens, or raise pigs. The current shortage of linseed meal, oil-cake, meatmeal, and the various commercial products made therefrom, is likely to persist for some considerable time and farmers will have to adopt every possible expedient if their livestock are to continue in efficient production. It is no easy matter to suggest substitutes for foods such as linseed meal or meatmeal, as these are so excellent for their respective tasks, but a lack of a proven supplement does not necessarily mean that production must fall. In this article comments are made concerning a few protein-rich foods which may be turned to advantage until the happy day when the producer can again buy what he wishes to use.

Young Pasture.

Young pasture is the cheapest and the best source of protein available to farmers. It is not generally realised that young mixed herbage usually contains more digestible protein per unit dry weight than do most of the commercial food stuffs for which a high price is willingly paid. Good quality pastures may have a digestible protein content approaching that of linseed meal, the protein is of high nutritive value, and with this protein the animal also receives a liberal supply of minerals and essential vitamins. The value of young pasture was shown very clearly in Britain during the war years when the oilcakes and meals normally used were no longer available. Dairy herds were maintained in high production while receiving nothing but the grazing from well managed pasture. It was found that a few high producing cows could not eat enough of the bulky green grass to permit them to produce to their maximum, so a concentrated supplement had to be fed. But because the short herbage was so rich in protein, the supplement needed was a carbohydrate such as is obtained from cereal grain, and not a protein-rich meal as is usually fed in Australia.

It should be stressed that management is the most important factor influencing the quality of a pasture during the growing period. Grasses, as well as clovers, will yield protein-rich fodder so long as the growth is kept young by repeated grazing or mowing. For example, young rye grass or paspalum has a protein content equal to that of clover but with progressive growth the quality falls rapidly. It follows that farmers, dairy farmers in particular, can do much to make themselves independent of outside supplies of protein if they make maximum use of small paddocks grazed in rotation so as to keep the herbage in a young stage for as long as is possible. Remember that it is not essential to have the best quality pasture plants before benefit can be obtained from controlled grazing. Naturally the best results are obtained when the most suitable seed mixtures have been sown down but too much emphasis cannot be given to the fact that good management is a more important factor than the plants composing the pasture.

Greenstuff.

Poultry farmers are suffering more than most producers from the current shortage of protein-rich foodstuffs. Many cut greenstuffs for their birds and at the present time it may be profitable to cut this material much earlier than is the general practice. By doing so the total yield of herbage may be definitely decreased but the much higher protein content will more than compensate for this loss. In experiments with *Phalaris* grass, for example, plants which were cut five times during the growing season yielded less than half the dry matter obtained from plants which were only cut at maturity. But the total yield of protein was trebled by the frequent cutting, so that a protein-rich foodstuff containing 22 per cent. protein was obtained. Likewise, if lucerne is cut just before flowering it could be expected to contain about 25 per cent. protein in the dry matter whereas if left until after flowering the protein will doubtless have fallen to about 10 per cent. As protein is the constituent in most urgent requirement at the present time, it follows that it will pay to cut greenstuff as young as is practicable. In this regard it may be noted that lawn clippings generally contain considerably more digestible protein than do most of the laying mashers now on the market. So don't waste lawn clippings!

Hay.

Hay made from young herbage naturally contains much more digestible protein than does hay made from more mature material. Where protein-rich foods are required, as for feeding dairy cattle or lambing ewes, it may pay to cut crops for hay at an earlier stage than is usual. Here again it is necessary to draw a balance between yield and quality. By cutting earlier, the yield of dry matter will not be so great but a much richer fodder will be obtained. A word of caution is needed here, however. If crops are cut for hay too early in the season the drying material may be exposed to rain before it is cured. Rain quickly washes out the most valuable nutrients in hay so that the anticipated gains from early cutting will be completely lost if rain falls before harvesting is completed. Once again it is a matter of judgment (not to mention good luck!). The farmer himself must decide just how early he can cut hay without undue risk of loss in feed value due to rain.

The influence of time of cutting on quality and yield was well demonstrated by Underwood and Moir (1944) who showed that wheaten hay cut when the ears were half emerged yielded 123 lb. digestible protein per acre whereas other portions of the crop cut at the early dough stage yielded only 34 lb. A delay in cutting can therefore result in a very marked decrease in the amount of useful protein conserved; even to wait until a wheat crop has finished flowering will probably halve the yield of digestible protein. A similar loss occurs in meadow hay if this is not cut as soon as practicable. These figures show all too well that wherever stock are in need of protein, the hay reserves should be cut as early as possible.

Leguminous Seeds.

Leguminous seeds are well known as sources of good quality protein and in the form of field peas and lupins have been much used in this State. It is indeed a pity that the ravages of the pea weevil have greatly reduced the area sown down with field peas as these provide an excellent source of protein for cattle, sheep, pigs and poultry. As a matter of interest it may be noted

that if linseed meal costs £14 per short ton, field peas are worth something more than six shillings per bushel of 60 lb., considered as a source of protein (for fattening, peas have the same value as linseed meal).

Blue Lupins.

Lupin seeds are very rich in protein, containing about 35 per cent. in the dry matter, compared with the 24 per cent. found in field peas. The use of the blue lupin as sheep feed needs no comment here but it is suggested that the areas where lupins are so useful may perhaps be extended by trials with the New Zealand blue lupin which will grow in heavier, water-logged soils on which the local variety does not thrive.

Tangier Peas.

It is a matter of surprise that Tangier peas are not more commonly grown in this State as they produce a heavy crop of palatable nutritious greenstuff persisting well into the summer and the seeds, which are produced in great quantity, contain more protein than any other harvested in this State. Tangier pea seed grown at Wonnerup and Dwarda contained 39 and 40 per cent. protein respectively and if these seeds could be harvested for sale they should prove a very rich protein supplement. Some of the members of the Tangier pea family (*Lathyrus spp.*) bear seeds which contain a poisonous principle and although there is no record in this State of the Tangier pea seed ever causing any trouble it will be necessary to make certain that they are harmless before being used in large amounts. The Department of Agriculture plans to carry out the necessary experiments this season but meantime would appreciate any information which could be supplied by those who have fed Tangier peas in quantity to stock. It is hoped that this high quality seed can be turned to commercial advantage.

Cereal Grain.

Wheat or oat grain is generally accepted as an energy or fat producing food and is rarely considered as a source of protein. However, in view of the fact that cereal foodstuffs are used so extensively by poultry and pig farmers who are in such urgent need for increased protein supplies, it is worthwhile considering the relative value of cereal grains when grown in different areas, as cereals from the Eastern wheatbelt contains appreciably more protein than do similar grains grown nearer the coast. It has been shown (Snook, 1939) that wheat grown at Merredin may contain 15 per cent. protein in the dry matter (average of 5 years) as compared with only 9 per cent. in the same variety grown at Wongan Hills or Chapman. Likewise, oat grain grown at Nungarin may contain 15 per cent. protein as compared with the 8 to 9 per cent. found in the same varieties grown at Beverley. The difference in these values is quite considerable and may perhaps justify the purchase of grain from (say) Merredin, rather than from Northam, if the wheat or oats is to be fed to poultry or pigs.

Shriveled grain, due to the lack of finishing rains, typically contains considerably more protein than does normal grain, so that screenings may be quite profitable buying to those seeking protein-rich foodstuffs. It may be mentioned,

incidentally, that the high protein content of Merredin wheats is not due to shrivelling, as the grains containing high protein were characteristically plump and attractive.

SUMMARY.

Many farmers will require additional supplies of protein-rich foods during the coming season and the following suggestions are made.

1. Maximum use should be made of young pasture, which is the ideal food for grazing animals.

2. Greenstuffs for poultry or dairy cattle should be cut while young, as it then constitutes a protein-rich supplement.

3. Crops for hay should be cut at a younger stage than is usually practised, as the decrease in yield will be compensated by the considerably higher return of digestible protein.

4. Risk of exposure of hay to rain damage during curing should be avoided as much as is possible.

5. Leguminous seeds should be used wherever they can be grown or purchased at a reasonable price.

6. Where large amounts of cereal grains are being purchased for pig or poultry food, efforts should be made to obtain material from the Eastern Wheatbelt.

REFERENCES.

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Recent Trials with Selective Weed-killers.

G. R. W. MEADLY, Assistant Government Botanist.

IN recent years the use of selective chemical weed killers has been stimulated by encouraging experiences with substances not previously used for this purpose. Before discussing these highly complex, but at the same time most interesting compounds, it is proposed to trace briefly the discovery and development of chemicals as selective weed killers.

Firstly, to define the term selective weed-killer: This is applied to chemicals capable of killing weeds growing in crops, pastures or lawns, without causing permanent injury to the sown plants.

Most discoveries in agriculture and other sciences have been the outcome of planned research and this is largely true in the case of weed-killers. One of the early discoveries, however, was accidental. Just fifty years ago the first experimental work with copper sulphate was carried out, after weeds growing under fruit trees had been killed following spraying of the trees with copper sulphate to protect them from disease. Bonnet and other workers soon found that by spraying a growing cereal crop with dilute solutions of this and other chemicals it was possible to kill many annual weeds without seriously affecting the crop. Substances that gained some popularity for this purpose included iron sulphate, sodium sulphate and, as powders, Kainit and Cyanamide, but, because of its low cost and non-corrosive properties, copper sulphate was the most widely employed material for spraying cereals.

Sulphuric acid was found to give very effective results against a wide range of annual weeds and moreover, as it acted quickly, did not require a long period of fine weather following application. The major difficulty associated with the use of sulphuric acid was, and still is, its corrosive properties, although this has been overcome to a certain extent by the use of special lead-lined sprayers. Most of the early experimental work with this acid was carried out in France, where tens of thousands of acres of cereal crops were treated each season.

Despite the great value of sulphuric acid for weed control under European conditions and the advances made in the manufacture of spraying equipment, the need for extremely careful handling in the field by workmen still presented a disadvantage and the search for more suitable alternative substances continued. It was not until 1932, however, that any further appreciable advance was achieved. A patent was then filed in France for the employment of certain yellow dye stuffs for selective weed control in cereals and other crops. These substances were by-products of the distillation of coal and subsequently in France, and then in America, the sodium salt of one known to chemists as sodium dinitro-ortho-cresylate was placed on the market. It is now sold under a variety of trade names that are easier to remember, including dinoc in Australia and sinox in America.

The commercial preparation is a dense suspension of fine crystals forming a paste consisting of 30% of the cresylate and 70% water. If allowed to stand, a watery layer forms above a firm mass of the chemical, thus necessitating thorough mixing before use. Dinoc has the advantage that it is not corrosive either to clothing or metals but, being a dye stuff, stains skin and clothing. It is toxic if taken internally in comparatively large doses and poisoning may also result from continued inhalation of spray particles, but it is relatively non-poisonous when compared with the compounds of arsenic used for killing weeds.

Experimental work has shown that the addition of an acid salt such as sulphate of ammonia increases the effectiveness of the dinoc. Such activated solutions are more toxic to all plants and in consequence may prove less selective in their action. They have their greatest value when there is a comparatively large difference of tolerance between the crop and the associated weed community.

It is quite apparent from the results of detailed experimental work carried out in Western Australia as well as the Eastern States and other parts of the world, that conditions, especially relative to temperature and moisture, have a decided influence on the reaction of both weeds and crops to applications of dinoc. Local trials have been conducted on weeds in onions, flax, cereal crops and lawns and much of this work has already been recorded.*

Probably the most spectacular advance in selective weed-killers has been provided by various derivatives of phenoxyacetic acid. In 1940 workers, while investigating the effects of spraying "hormones" or growth promoting substances on cereals noted that one substance normally used to induce cuttings to root quickly, killed some of the annual weeds but not the cereals growing in the experimental pots. It was at once apparent that this substance possessed certain "Dr. Jekyll and Mr. Hyde" characteristics and a search was immediately instituted to find related compounds that would prove more active as selective weed-killers. By the end of 1942 two new materials had been selected as most promis-

*Dinoc—A Selective Weed-killer—G. R. W. Meadly, *Journal of Agriculture, W.A.* Vol. XXII No. 4, December 1945.

ing. Both are complex organic compounds and have in consequence long complicated names—2-methyl-4-chloro-phenoxy-acetic acid and 2:4 di-chloro-phenoxy-acetic acid. Fortunately more simple trade names have been given to proprietary lines of these substances, which are now being distributed under such names as methoxone, weedone and di-weed.

These "hormone" weed-killers are quite unlike other selective weed-killers. They act very slowly and their effectiveness is not dependent upon absorption through the leaves. This ability to cause slow destruction by root absorption means not only that the efficiency of the application is little affected by weather conditions but that any weed seeds of susceptible species that have germinated and are still below the surface may also be killed.

It is impossible to forecast with any degree of certainty the effect of dinoc or the "hormone" weed-killers on many types of weeds, and experiments have been undertaken to ascertain the relative efficiency of different products.

1. Double gee (*Emer australis*).

An experiment was commenced at the Merredin Research Station on 1st July to ascertain the effect of dinoc and methoxone on seedlings of double gee, one of the worst weeds of the agricultural and pastoral areas. The treatments consisted of—

- (1) Control (unsprayed).
- (2) 0.1% methoxone.
- (3) 0.2% methoxone.
- (4) 1.0% dinoc + 2 lbs. sulphate of ammonia per 100 gallons.

Each treatment was applied in the form of a fine spray to 1/300 acre plots replicated six times. The spraying, carried out in the morning, was followed by five points of rain on the day of application. A further 29 points was spread evenly over the remainder of the week. The soil is a clay loam and the double gees were in the young seedling stage, many not having developed more than cotyledonary leaves.

Three days after spraying a general withering and drying of the double gee leaves had occurred on the dinoc plots and only a very limited number of plants eventually recovered. Both methoxone treatments causing a yellowing of the plants and retarded their growth, besides inducing a more erect habit, but caused no marked difference in plant numbers compared with the controls. The effect of 0.2% methoxone was somewhat more conspicuous than the weaker solution. The following table shows means based on examinations made on 5th September, the figures representing surviving plants in five square link throws. Owing to the extreme effect, treatment 4 was omitted from the statistical analysis.

Treatment No.	Mean	Reconverted Mean
1	44	43.26
2	43	42.73
3	28	27.90
4 .. .. .	.05	

Difference necessary for significance of $\sqrt{x} = 0.901$ (1% level).

In all cases the data has been transformed in order that the analysis of variance could be validly applied. The symbol x has been used throughout as an abbreviation for the reconverted mean in connection with significant differences.

From the analysis of variance it has been shown that the means for treatments 1 and 2 are greater than for 3 so that 0.2% methoxone has given a significant reduction of double gee. The outstanding control, however, was achieved with 1% dinoc.

Besides the heavy infestation of double gees a quantity of Wimmera rye grass (*Lolium rigidum*), barley grass (*Hordeum murinum*) and canary grass (*Phalaris minor*) occurred on all plots. The spray applications did not result in any permanent injury to these plants which were flourishing when the counts were made in September.

The experimental work was followed by the treating of seedling double gees in the cereal test rows at the Research Station with 1.0% dinoc supplemented by 2 lbs. of sulphate of ammonia per 100 gallons of solution. Satisfactory results were obtained with applications as low as 100 gallons per acre.

The cost of materials and application prevent the use of dinoc for controlling double gees over extensive areas but it has saved much labour and expense with experimental plots which otherwise would have required hand weeding. Its use may prove convenient and practical for comparatively small areas of double gees, especially where they cannot be cultivated readily.

2. Capeweed (*Cryptostemma calandulaceum*).

An experiment with the same design as that described for double gee was carried out with capeweed on a sandy soil at the Wongan Hills Research Station. The chemicals were applied on 8th July when the capeweed varied from young seedlings to small plants, 2-3 inches across. The infestation was very dense with plants of few other species present. Six points of rain fell after the chemicals had been applied on 8th July and a further inch was recorded during the following four days.

Observations made on 26th July showed that the dinoc had given complete control of the capeweed but both methoxone treatments had only caused a slight tipping of the leaves. There was no subsequent recovery of the capeweed on the dinoc plots and the apparent effect of the methoxone did not increase. Quite effective results with seedling capeweed have been obtained with field trials in various parts of the State by using 100 gallons per acre of 1% dinoc containing 2 lbs. of sulphate of ammonia per 100 gallons of solution.

3. Rapistrum weed (*Rapistrum rugosum*).

A trial was conducted at Mingenew to ascertain the effects of a dinoc solution and different concentrations of methoxone on Rapistrum weed which is also referred to as turnip weed. The treatments were as follows:—

1. Methoxone—1 lb. per acre—100 gallons 0.1% solution. Applied at 2-4" rosette stage.
2. Methoxone—2 lbs. per acre—100 gallons 0.2% solution. Applied at 2-4" rosette stage.
3. Dinoc—1 gallon per acre—100 gallons 1.0% solution, plus 2 lbs. sulphate of ammonia per 100 gallons. Applied at 2-4" rosette stage.
4. Methoxone—1 lb. per acre—100 gallons 0.1% solution. Applied at commencement of flowering.
5. Methoxone—2 lbs. per acre—100 gallons 0.2% solution. Applied at commencement of flowering.
6. Control.

The six treatments were randomised within five blocks, individual plots being 1/100 acre. Treatments 1-3 were applied at midday on 3rd July. A light shower of rain followed the completion of the spraying. There was a satisfactory distribution of Rapistrum weed over the experimental area, the plants ranging from seedlings to small plants 3-4 inches across with six well developed leaves.

On August 13th weed counts were made on treatments 1, 2, 3 and 6, ten randomised one-square-link counts being made for each plot. Both concentrations of methoxone had given complete control of rapistrum weed without causing injury to the natural pasture consisting mainly of grasses. There appeared to be fewer rapistrum plants on the dinoc sprayed plots compared with the controls but the difference was not conspicuous. The plants were up to twelve inches across and some of the smaller ones had certainly appeared after the chemicals had been applied early in July. The methoxone undoubtedly affected seedlings which commenced development subsequent to the application of the chemical.

Treatments 4 and 5 were applied on 13th September when the more advanced plants had just commenced flowering. The day was fine and warm. Observations and counts made on these plots on 17th October revealed that methoxone had given a high degree of control with both concentrations and no seed formation had taken place. The results of this experiment are summarised in the following table, the numbers representing surviving plants per ten square link throws:—

Treatment No.	Mean	Reconverted Mean
1	0	.004
2	0	.004
3	7.0	6.15
4	0.4	0.32
5	0.4	0.27
6	16.2	15.34

Difference necessary for significance of $\sqrt{x + \frac{1}{2}} = 1.16$ (1% level).

The analysis of variance showed that the mean for treatment 6 was greater than for 3 which in turn was greater than for 1, 2, 4 and 5.

4. Flat weed (*Hypochoeris radicata* and *H. glabra*) and annual clovers (*Trifolium spp.*).

The species of *Hypochoeris* are two of the most troublesome lawn weeds in Western Australia and cause concern to keepers of bowling greens, golf courses and tennis courts along with the home gardener. Being a perennial, *H. radicata* is more difficult to control but large plants of *H. glabra* leave bare depressions when they die in the early summer, an unsatisfactory condition for playing areas where an even surface is necessary.

Annual species of clover such as hop (*Trifolium procumbens*), suckling (*T. dubium*) and woolly (*T. tomentosum*) occur freely as winter weeds in lawns. They are encouraged by many home gardeners as they introduce a pleasing green to an otherwise drab lawn in the winter but on playing surfaces such as bowling greens, golf greens and tennis courts clovers are a decided disadvantage.

Two experiments were designed to ascertain the relative value of various concentrations of dinoc and "hormone" weed-killers when applied to lawns containing flat weed and clovers.

Experiment 1.—The initial treatments were as follows:—

1. Methoxone 0.1%, 100 gallons per acre.
2. Methoxone 0.2%, 100 gallons per acre.
3. Methoxone 0.4%, 100 gallons per acre.
4. Dinoc 1% + 2lbs. sulphate of ammonia per 100 gallons, 100 gallons per acre.
5. Dinoc 1% + 2 lbs. sulphate of ammonia per 100 gallons, 400 gallons per acre.
6. Dinoc 1% + 10 lbs. sulphate of ammonia per 100 gallons, 100 gallons per acre.
7. Dinoc 1% + 10 lbs. sulphate of ammonia per 100 gallons, 400 gallons per acre.
8. Control.



One month after spraying. The two conspicuous plots free from clover are treatments 5 and 7. A control plot with a dense growth of annual clovers is partly shown on the left, while the foreground is untreated beyond the experimental area.

The plots were randomised in three blocks, each plot consisting of 1/400 acre. The treatments were applied between noon and 2 p.m. on 6th August. Light showers fell during the afternoon with a total of 11 points for the day. The falls for the subsequent four days were 17, 10, 34 and 133 points. The weed infestation was heavy, the flat weeds being up to three inches across and the clovers of comparable size while the couch grass (*Cynodon dactylon*) was in a dormant condition.

Observations made on the 28th August showed that treatments 5 and 7 had proved very effective against the annual clovers causing a complete drying from which no recovery had been made. The flat weeds, although dried to the same extent, already showed an appreciable amount of regrowth. The corresponding

lower rates of application of dinoc represented by treatments 4 and 6 were less effective but indicated that 1% dinoc with 2 lbs. of sulphate of ammonia per 100 gallons would give satisfactory control of clover at an application rate of 200 gallons per acre. This was confirmed by subsequent applications to playing areas. The cost of such treatment amounts to 4/- for materials sufficient to spray a tennis court and its proximity. The increased ammonia content caused no apparent improvement. The clover on the 0.1% methoxone plots was slightly browned and the growth was somewhat suppressed compared with the controls. The 0.2% and 0.4% plots showed proportionately greater browning and growth suppression. Although there was little alteration in the colour of the flat weeds some growth abnormalities were apparent on all plots.

By 4th September the flat weed was again vigorous on all dinoc plots, but the clover had shown no regrowth on treatments 5 and 7 and little recovery on 4 and 6. It was also noted that the 400 gallons per acre dinoc plots contained little silver grass (*Vulpia spp.*) which was present in quantity on all other plots.

The clover on the methoxone plots had further deteriorated compared with the controls. Many flat weed plants were dry and shrivelled while others showed abnormal twisting and vertical disposition of the leaves.

On the 16th October, half of each plot was sprayed with 0.4% methoxone at the rate of 100 gallons per acre. This meant that methoxone was superimposed on all previous treatments and half of each control plot received its first application. The day was cloudy but fine. It soon became apparent that the double application of 0.4% methoxone represented the most effective combination of treatments for controlling the flat weed. The following table includes figures for surviving plants in ten square links, (b) representing the half plot sprayed with 0.4% methoxone on 16th October. The figures for (b) did not lend themselves readily to statistical treatment and were therefore excluded from the analysis of variance.

Treatment No.	Mean	Reconverted Mean
1 (a)	74.7	74.13
(b)	6.0	
2 (a)	43.3	42.66
(b)	3.0	
3 (a)	16.3	14.45
(b)	0.7	
4 (a)	112.0	104.7
(b)	9.7	
5 (a)	54.0	52.48
(b)	3.3	
6 (a)	68.7	51.29
(b)	5.3	
7 (a)	72.0	69.18
(b)	18.0	
8 (a)	83.3	
(b)	14.7	

Difference necessary for significance of $\text{Log } x = 0.410$ (5% level).

Analysis of the figures showed that the mean for treatment 3 was less than all other treatments, which did not reveal significant differences *inter se*.

An indication of the cost can be gleaned by the fact that sufficient methoxone for two applications to a tennis court of a 0.4% solution at the rate of 100 gallons per acre is £1.

Experiment 2.—This experiment was designed to compare the effects of two proprietary "hormone" weed-killers, methoxone and di-weed on flat weed. The site was again a weed infested couch lawn at South Perth and the treatments were as follows:—

1. 0.2% methoxone—100 gallons per acre.
2. 0.4% methoxone—100 gallons per acre.
3. 0.2% 2-4 di-weed—100 gallons per acre.
4. 0.4% 2-4 di-weed—100 gallons per acre.

1/400 acre plots were randomised in five blocks and the solutions were applied on 15th November, a fine warm day. Counts were made on 17th January when it was apparent that the di-weed had proved more effective than the methoxone at equal concentrations. Practically 100% control had been obtained with the 0.4% di-weed as shown by the following table listing the number of surviving plants per ten square links:—

Treatment No.	Mean	Reconverted Mean
1	26	23.0
2	9	8.9
3	8	8.2
4	0.4	0.32
5	125	124

Difference necessary for significance $\log (x + 1) = 0.312$ (1% level).

The analysis of variance showed that the means for all treatments with the exception of 2 and 3 differed significantly from each other.

At no time during the course of these two experiments was the couch grass obviously affected by the chemicals.

Besides the detailed experimental work which has been described, exploratory trials have been conducted with methoxone on blackberry (*Rubus fruticosus*), St. John's wort (*Hypericum perforatum* var *angustifolium*), Berkheya thistle (*Berkheya rigida*) and water hyacinth (*Eichornia crassipes*). The results with water hyacinth were sufficiently encouraging to warrant further experimental work but the chemical had little effect on the other species.

CONCLUSIONS.

Although members of the Cruciferae (cabbage family) can be regarded as a group susceptible to "hormone" weed killers it is difficult to anticipate the effect of the various "selective" chemicals on different species.

Dinoc was found eminently satisfactory for the control of annual clovers, capeweed and seedling double gees, while the phenoxy-acetic acid derivatives (methoxone and 2-4 di-weed) were less effective against these species but gave much better results when applied to Rapistrum weed and flat weed.

With Rapistrum weed, methoxone caused a high degree of mortality when applied at all stages of growth up to flowering. The "hormones" gave better results with flat weed when applied in the spring and summer than during the winter. This is probably associated with the more active growth linked with the higher temperatures.

Capeweed and annual clovers become more resistant to dinoc as the plants increase in size but can be largely controlled at the later stages of growth by increasing the concentration and rate of application. The same cannot be said of double gees which must be treated when in the young seedling stage before typical leaves have been formed.

The cost of materials restricts large scale use of these chemicals in Western Australia, but they have considerable value for local infestations of susceptible plants. Their use as selective weed-killers for playing areas such as golf links, tennis courts and bowling greens is sure to increase.

At the concentrations employed the hormones had no adverse effect on couch grass (*Cynodon dactylon*) or any of the naturalised grasses. Dinoc, especially with the higher rates and concentrations caused some tipping of couch grass and cereals, but recovery was comparatively rapid. The bent grasses (*Agrostis spp.*) including brown top are more likely to be permanently affected, especially when sulphate of ammonia has been used as an activator. Dinoc should be used with extreme care on such swards.

ACKNOWLEDGMENT.

My thanks are due to fellow officers of the Department of Agriculture for assistance in carrying out the experiments described: also to Timbrol Ltd., Imperial Chemical Industries Ltd., and the Nightingale Supply Co. Ltd., who provided the dinoc, methoxone and 2-4 di-weed used in these experiments.

A Simple Method of Handling Feed Wheat in Bulk.

W. M. NUNN, Agricultural Adviser.

NOW that wheat for stock feed purposes is supplied in minimum 10-ton bulk truck loads, it has become necessary for farmers to make special arrangements for receiving wheat in bulk and for storing it in bulk on the farm.

Bulk handling and storing of feed grains has many advantages over bags. In the long run it is much more economical. Not only is the cost of the bag saved, but handling costs are minimised and so also are losses from mice, rats and weevils.

On properties in the Wheat Belt, where the conservation of feed reserves in the form of cereal grain has become a familiar practice, quite a number of bulk storage installations are to be found, varying of course, from elaborately constructed bins, to improvised structures of a temporary nature, according to the farmer's requirements.

Methods of filling the bulk container also vary. In some cases an elevator is justified, and in others steeply rising ground enables the bin to be loaded at one side and emptied at the other. In the majority of cases however, a great deal of handling is necessary in lifting bags to a staging and then tipping them into the bin.

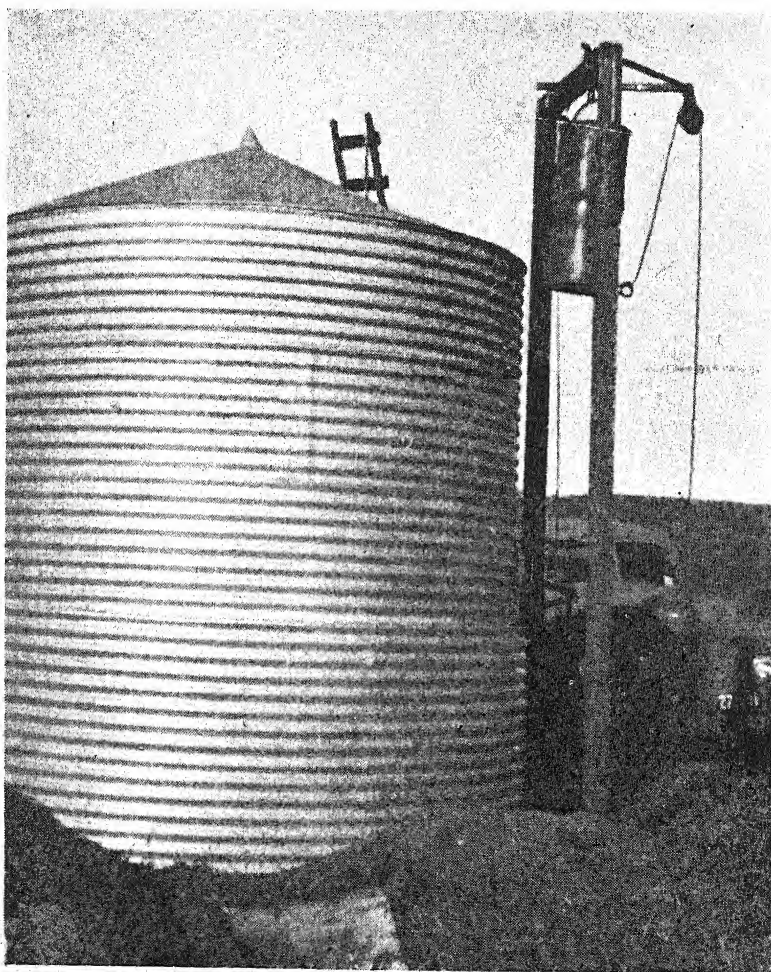
Now that poultry farmers and pig raisers must accept wheat in bulk, a greater number of people are interested in ways and means of simplifying the handling and storing of bulk grains, and the following description is given of a

bin and hoisting gear which is giving satisfactory service on the property of Mr. H. E. Braine, at Chittering. Mr. Braine is manager of the Wheat Pool of W.A. and through the Pool will be happy to assist others with advice and material to enable them to construct a similar outfit.

The bin consists of a tank of corrugated galvanised iron. The grain is transported from the siding either in a bulk container on the buyer's motor truck, or in open mouthed or loosely tied stacks, and is shovelled from the container or tipped from the bags into a wheat bucket which is then hoisted by means of a simple winch and wooden gallows, for emptying into the bin.

The equipment necessary for this installation is:—

A 3,000 gallon galvanised corrugated iron tank, 24-gauge with 22-gauge bottom and waterproof cone top. The tank should have two sliding doors fitted opposite each other near the bottom and the top should have a 2-ft. diameter manhole or opening to receive the wheat.



View of the bin and hoisting gear in operation on the property of Mr. H. E. Braine, at Chittering.



Another view of the bin and hoisting gear in operation on the property of Mr. H. E. Braine, of Chittering.

A galvanised corrugated iron stand of 24-gauge iron, two sheets high. (Alternatively this could be made from wood on the farm.) If the iron ring stand is used, it is some inches greater in circumference than the tank bottom. The ring is filled with sand and the space between tank bottom and outside edge of ring is cemented.

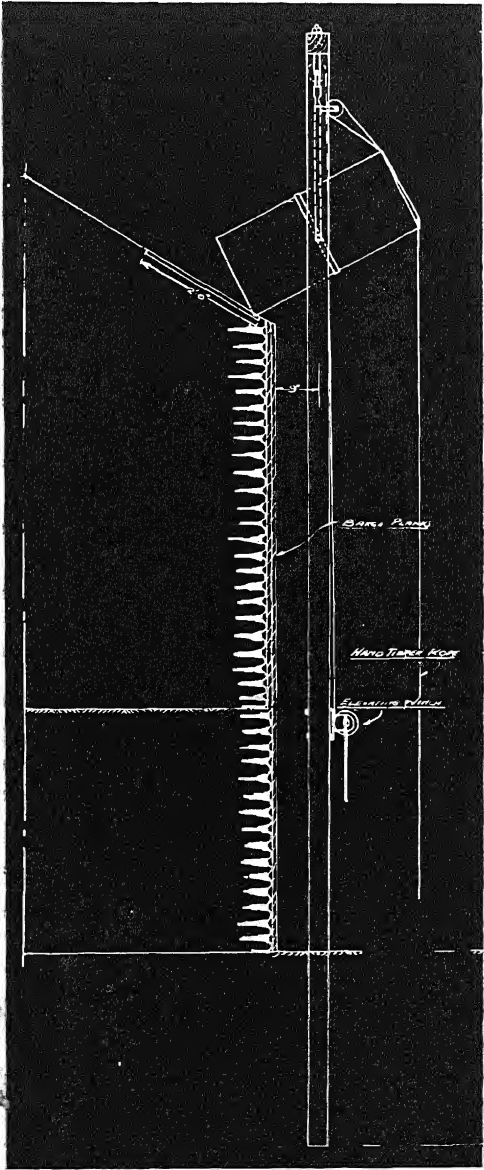
A hoisting frame or gallows. This could be made of 4 x 4 jarrah up-rights with a 4 x 4 cross piece or could be constructed from bush pole timber available on the farm.

A wheat bucket, winch, sheave wheels, rope and fittings.

Such an installation would cost only about £30 which is approximately equal to what would be the cost of purchasing and filling 250 cornsacks if they were obtainable at present nominal prices. However, new cornsacks are not obtainable, and the price, when they are, should be very much higher.

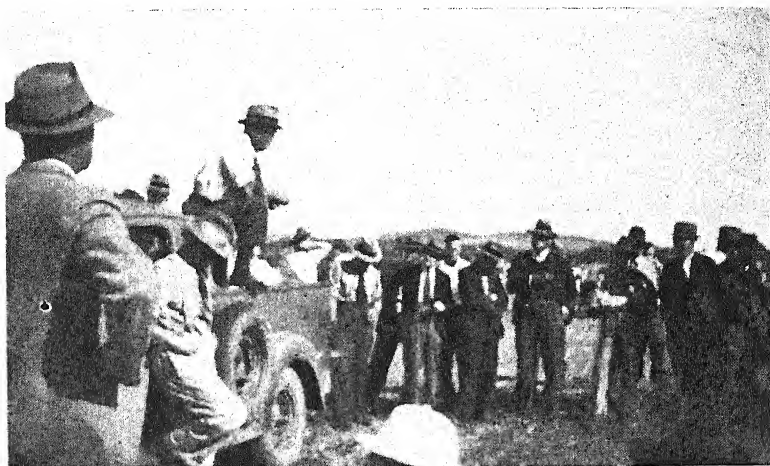
The present approximate cost of equipment would be:—

Tank	..	..	..	£18	Perth or Fremantle.
Stand	..	..	..	£1	" "
Timber Gallows	..	..	..	£1	
Hoisting Gear	..	..	..	£6	



Advisory Service In The Wheatbelt.

I. THOMAS, Superintendent of Wheat Farming.



Mr. G. L. Throssell addressing farmers at the Chapman Research Station, Field Day, 1946.

FARMING is not only a basic part of the nation's economy, providing raw materials for vital human requirements, but it is also the way of life for many people. Its appeal to the individual, as a means of livelihood, is naturally related in no small measure to the important feeling of being engaged in an interesting and absorbing occupation, with a high level of technical efficiency.

There is an evolutionary sequence in the development of every farm and most properties are now entering the most complex stage calling for the adoption of efficient practices in respect to crop rotations, the exact use of fertilisers, the use of high quality animals, and the best strains of pasture and crop species to suit the locality and its soils.

In respect to livestock, sheep and pig numbers have increased markedly in the wheatbelt, and it is likely that an even greater proportion of the farm income will be derived in future from livestock. Most livestock owners will encounter from time to time, expensive losses sufficient to absorb the profit margin, unless adequate precautions are taken to prevent parasite infestations and disease epidemics.

During the dry summer months, supplementary feeding will be required whilst the lambing percentage is dependent on the level of feeding of the ewes during the last six weeks of pregnancy. These varied aspects of animal husbandry all require the application of the most recent developments in research. The link between the farmer and the research worker is the extension officer whose function it is to maintain contact with both. Often the results of research as published do not apply to local conditions, and to use the findings it is necessary usually, to convert them to a routine farm operation capable of being applied on

any holding. For this reason the Wheat Branch now has highly qualified advisers stationed at Geraldton, Beverley and Kellerberrin, who will be pleased to assist farmers and others in obtaining information on agricultural and allied subjects.

The officers stationed in the various districts can be contacted either by letter or telephone at the following locations:—

GERALDTON (Government Bldgs.), Mr. G. L. Throssell, B.Sc., (Agric.).

BEVERLEY (Court House.), Mr. A. J. T. Marshall, B.Sc., (Agric.).

MERREDIN, Mr. E. R. Watson, B.Sc., (Agric.).

KELLERBERRIN (Court House), Mr. E. R. Watson, B.Sc., (Agric.).

Leaf Spot Disease of Black Mulberry.*

W. P. CASS SMITH, Government Plant Pathologist.

R. STEWART†, Department of Botany, University of W.A.

UNTIL a few years ago the black mulberry (*Morus nigra*) was affected by only one troublesome disease in Western Australia, namely bacterial blight caused by *Bacillus mori*.

In April 1943 a fungal "leaf spot" disease was also recorded for the first time, which has since spread so rapidly that it now occurs in practically all areas of the State where mulberries are grown.

Compared with most other fruit trees here, mulberries are of little economic importance. According to the Government Statistician, only 190 bushels of mulberries valued at approximately £950 were marketed during the 1945-46 season.

However, they are easily grown, even on our poorer sandy soils, and in consequence have been planted in many home gardens and orchards, mainly as single trees, and are prized as a source of fresh fruit.

In both the 1945-46 and 1946-47 seasons, this "leaf spot" disease developed very seriously, superseding the bacterial blight in importance. As a result many requests were received for information regarding control measures.

*Partly prepared in condensed form from a thesis presented by Miss R. Stewart, B.Sc., to the Department of Botany, University of W.A., in February, 1947, in part fulfillment of the requirements of an Honours degree. The complete thesis entitled "Investigations on the "Leaf Spot" Disease of Black Mulberries caused by *Septoglossum mori* (Briosi and Cavara)," will probably be published subsequently in the Jour. Roy Soc. of W.A.

†First Class Honours Graduate who investigated this disease under the supervision of the senior author.

Symptoms and Effects.

The disease appears to be confined to the leaves, for no evidence of wood infection has yet been discovered, despite careful search. On the leaves the disease is generally first noticeable early in the growing season, in the form of small dark brown, or blackish spots (1-2 mm. in diameter), usually surrounded by a zone of light green or yellow tissue. Under favourable conditions the leaf spots gradually enlarge and the central portions become whitish in colour. As they enlarge numerous very small black dots or pustules develop on the surface of the lesions which become most obvious in the pale central portions.

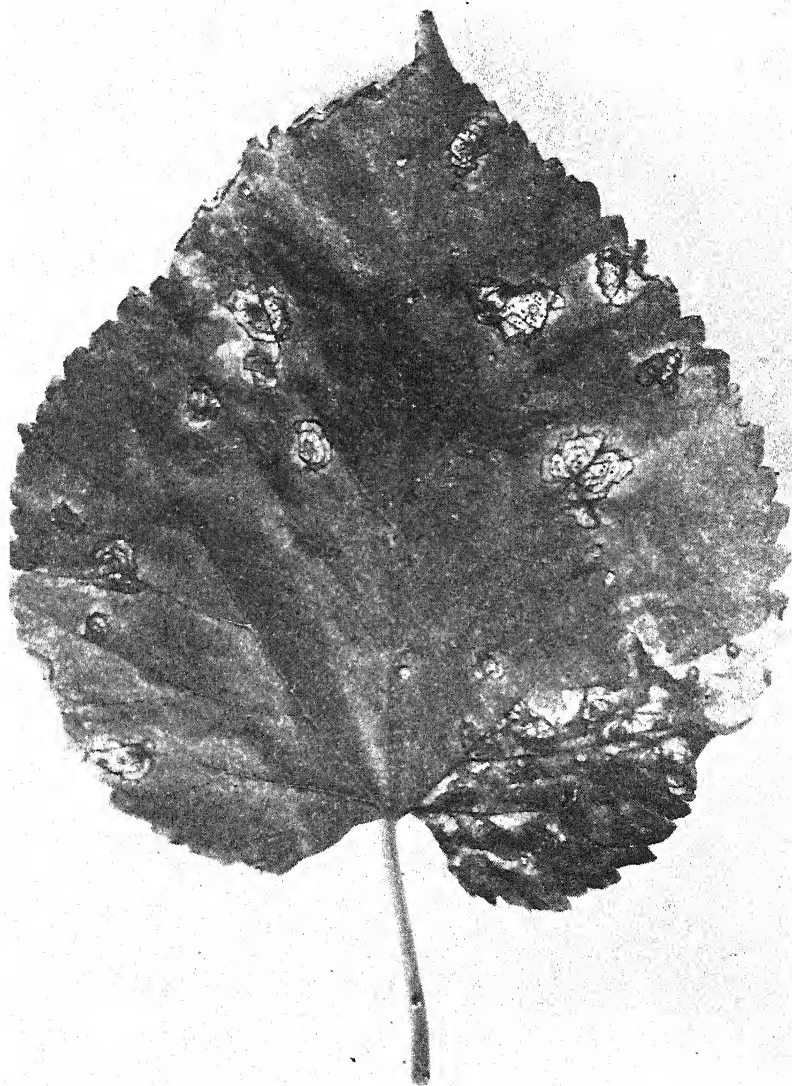


Fig 1.

"Black-spot" symptoms due to the fungus *Septogloeum mori*.

In wet, humid weather, the pustules become upraised and distinctly pin'ish in colour. These are the fruiting structures of the causal fungus which will be referred to later.

Enlargement of the leaf spots may continue until they are 10 mm. or more in diameter, when they typically appear more or less regular in outline, with dark brown margins and whitish centres. Infection also causes a browning of the veins in the vicinity of the necrotic area. The light green or yellowish areas which usually surround the spots vary considerably in extent. If the spots are close together, they coalesce as they enlarge, and when numerous or very large, extensive areas of leaf tissue wither and die. (Fig. 1). Leaves badly affected in this way soon fall from the tree.

When, as a result of the disease, severe defoliation occurs, the tree is weakened, and if this takes place early in the season, a reduced setting or a heavy premature drop of fruit is brought about.

Cause of the Disease.

Leaf spot of mulberries is caused by a fungus *Septogloeum mori* (Briosi and Cavares). If a thin transverse section is cut through a well developed leaf spot, and examined under the microscope, the minute black dots which were visible to the naked eye are seen to consist of structures similar to that shown in figure 2. These are the fruiting bodies (acervuli) of the causal fungus.

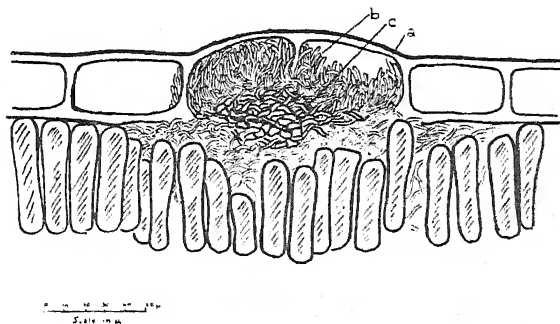


Fig. 2.

Transverse section of mulberry leaf, showing structure of fruiting body (acervulus) of *S. mori* (semi-diagrammatic).
a. Outer wall of upper epidermis of leaf. b. Spore mass.
c. Stromatic layer.

Essentially they consist of a flat plate (stroma) of dark, closely interwoven, fungal threads, from which arise numbers of short erect spore bearing branches (conidiophores). The fungal seeds or spores (conidia) which develop singly at the ends of the branches, are elongated in shape (length being approximately eight times width), thin walled and colourless, and divided usually by two or three cross walls.

The fruiting body or acervulus is formed beneath the epidermis of the leaf and during its development the epidermis is subjected to increasing stress. Finally when the fruiting body is mature the epidermis ruptures during wet, humid weather and the spores are exposed as a pinkish upraised mass (fig. 3).

The production of spores of this kind continues when conditions are favourable throughout the growing season of the tree, but in autumn when the vigour of the leaves is declining, spores of a different kind were found by Miss Stewart developing in the same fruiting bodies (fig 3 inset). These are thick walled, dark in colour, divided by from 1-9 cross walls, and in form somewhat resembling a string of beads.

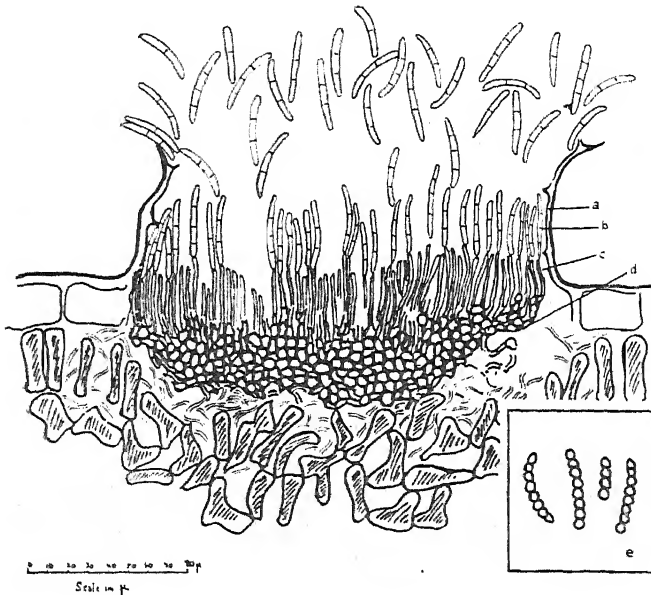


Fig. 3.

T. s. of fruiting body of *S. mori* at later stage than shown in fig. 2 (semi-diagrammatic). a. Ruptured outer wall of leaf epidermis. b. Thin walled spores (conidia) which serve to spread the disease during the growing season. c. Spore-bearing branches (conidiophores). d. Layer of interwoven fungal threads (stroma) from which the spore bearing branches arise. e (inset). Thick walled spores which develop in autumn, in the same fruiting bodies. Spores of this kind probably play an important part in the seasonal carry-over of the fungus.

Disease Development and Seasonal Carry-over.

After bud-burst in the spring, leaf spot symptoms of the disease usually first appear about a fortnight or so after heavy rains. In these infected areas fruiting bodies later develop, from which during wet weather are released the pinkish masses of thin walled spores. Spores of this kind serve to spread the disease rapidly during the growing season when conditions are favourable.

The spores are disseminated by wind and rain and some eventually lodge on other mulberry leaves. If hot dry weather prevails subsequently, however, most of these spores perish, but if conditions are cool and wet, the spores germinate in moisture and cause infection by sending out tiny infection threads which penetrate the leaves through the breathing pores (stomata) on the lower leaf surfaces.

From these infections other leaf spots develop, from which new spores arise, and this cycle continues while the weather conditions are favourable to the disease.

The last two seasons have been characterised by showery weather during late spring or early summer, conditions, which allowed the disease to reach epidemic form early in the growing season. As a result of the numerous leaf infections and severe early defoliation caused, the setting of fruit was reduced considerably in some cases, and in others a heavy premature drop of nearly mature fruit occurred.

With the advent of hot dry summer weather the disease becomes quiescent, but with the return to moist conditions in autumn it again becomes active.

The manner whereby the fungus is carried over from season to season is of great importance particularly in relation to control measures. Although extensive searches have been made, no evidence has yet been found of infected woody parts in which the fungus could persist during the winter months, neither has a sexual stage of the fungus been observed, either under natural conditions, or in artificial culture.

It seems unlikely that the thin walled spores which spread the disease during the growing season play any part in the seasonal carry-over of the fungus, except perhaps on rare occasions. They are quite unsuited to this purpose, as they germinate freely in moisture, and when dried infected leaf material is stored in the laboratory over the winter months, less than 1 per cent. of the spores remain viable. On the other hand, the thick walled spores which develop as the leaves are yellowing in autumn, appear to be ideally suited to the persistence of the fungus.

When naturally infected leaf material is held over winter, exposed to natural climatic conditions, more than 80 per cent. of these thick walled spores remain viable, and are capable of reproducing the disease, as shown in pathogenicity tests.

Aspects of this seasonal carry-over problem require further investigation, however, and it is hoped that these will shortly receive attention.

Control Measures.

Fortunately the disease has proved to be fairly easily controlled, even under conditions suited to epidemic development, by Bordeaux mixture or lime sulphur sprays, applied during the growing season.

Destruction of overwintering leaves would also appear to be a matter of importance from the control aspect, in view of the evidence which links them with the seasonal carry-over of the organism.

The following measures are therefore recommended to control the disease:

- (1) At leaf fall in autumn rake up the fallen leaves, and destroy them either by burning or by burying them deeply in the ground.
- (2) Just as the buds commence to swell in spring, spray the trees thoroughly with either lime sulphur 1:15 strength, or Bordeaux mixture 6:4:40 strength.
- (3) About a fortnight later apply a second spray, either lime sulphur 1:50 strength, or Bordeaux mixture 3:4:40 strength.
- (4) If subsequent to the second spray application, dry weather prevails, further sprays may be unnecessary. If wet weather prevails, however, further protection from the disease will be afforded by applying a third spray after the fruit is set, consisting of lime sulphur 1:100 strength or Bordeaux mixture 2:4:40 strength.

With each spray mentioned above, calcium caseinate at the rate of $\frac{1}{2}$ - 1 lb. per 40 gallons should be incorporated as a spreader.

ACKNOWLEDGMENTS.

Grateful acknowledgement is made by the senior author for assistance received during the course of this investigation from colleagues, Mr. H. L. Harvey and Miss O. Goss, of the Plant Pathology Branch, W.A. Department of Agriculture.

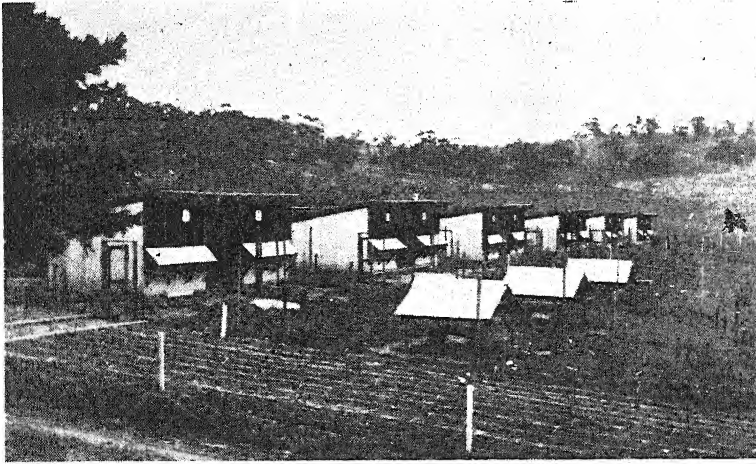
The authors also desire to thank the Superintendent of Horticulture, Mr. H. R. Powell, for enlisting the aid of certain members of his staff in reporting the distribution of the disease and collecting and submitting specimens. In the latter connection they particularly wish to thank Mr. E. H. Elkington.

Poultry Feeding Experiments Conducted at the Muresk Agricultural College with Laying Hens.

AN OUTLINE OF TRIALS NOW IN PROGRESS.

R. H. MORRIS, Agricultural Adviser.

POULTRY farmers have experienced considerable difficulty in obtaining desired supplies of mill offal with which to make up laying mash for their hens. There is no indication that supplies of these materials will increase in the immediate future and experiments are now being carried out to test the value of poultry rations which contain minimum amounts of the relatively scarce foodstuffs.



A general view of the six sheds and 12 runs. Only three of the 12 shade covers over the water-troughs had been completed when this photograph was taken.

At the same time it would be interesting to ascertain the part which two of our most common grains, namely wheat and oats, can play in compounding rations for laying fowls.

Meatmeal is not as plentiful as we would like it to be and these above-mentioned combined facts have prompted the Agricultural Department to carry out a series of poultry feeding experiments, which are being conducted at the Muresk Agricultural College strictly on a practical basis.

The experiments have the following aims:—

1. To determine if whole wheat grain is an economical substitute for wheat-meal.
2. To determine if crushed oats can be used to replace mill offal.
3. To determine if crushed peas in conjunction with whole wheat and wheat-meal, can be used to replace mill offal.
4. To determine the economy of feeding whole wheat and whole wheat plus crushed oats combined with 10% meat meal.

The rations being fed on a weight basis are as follows:—

Group.	Bran.	Pollard.	Wheat Meal.	Meat Meal.	Crushed Peas.	Wheat.	Crushed Oats.
1	30	10	50	10	...	...	...
2	30	10	...	10	...	50	...
3	10	10	...	10	...	50	20
4	...	...	30	10	10	50	...
5	...	...	...	10	...	90	...
6	...	...	...	10	...	60	30

Rations 1-4 supply approximately 15% crude protein, which approaches the optimum level which can be attained by commercial producers with the foodstuffs now available. Rations 5 and 6 supply only about 14% crude protein but it was not considered advisable to increase the proportion of meatmeal above 10%

so long as supplies of animal protein are rationed. The various rations are mixed in quantity to ensure uniformity of quality and placed in twelve 44 gallon drums which have been converted into dry feed hoppers.

Field peas are not now available for feeding to poultry but where these can be grown at a reasonable cost they constitute an excellent protein-rich food for growing and laying hens. In an endeavour to obtain some index of the value of field peas to poultry a group receiving 10% crushed peas has been included.

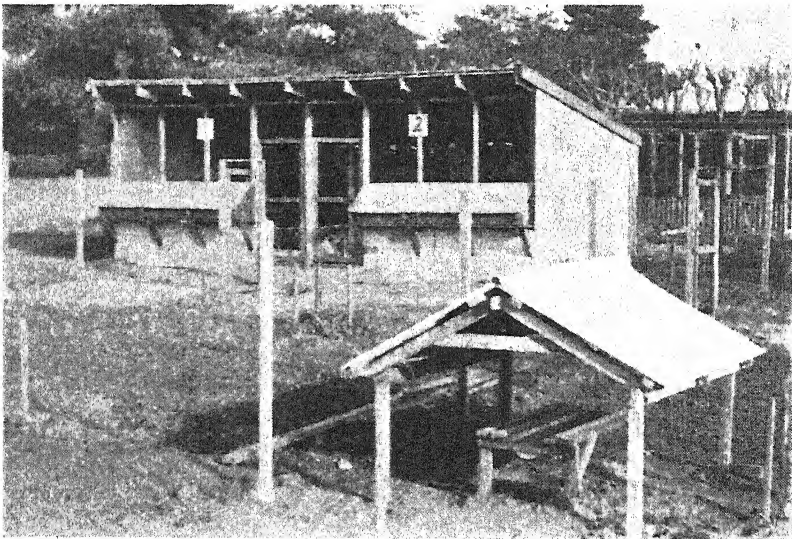
A mineral mixture consisting of five parts ground limestone and two parts bonemeal is available to the birds at all times. Common salt at the rate of 0.5% of the total ration is mixed in with the mashes or (in pens 5 and 6) mixed with the water used to dampen the whole grain prior to mixing in the meatmeal.

Each experimental group comprises 50 white leghorn pullets housed in odd numbered pens and 50 Australorp pullets housed in even numbered pens.

Each pen of fowls has access to its particular ration during the day from the dry feed hoppers. In addition a suitable quantity of these rations is fed as a wet mash to the respective pen each morning.

One half a kerosene tin full of finely cut greens is provided to all pens every evening and shell grit is always available.

The experiments are to extend over a period of twenty-four months from April 1st, 1947, to March 31st, 1949.

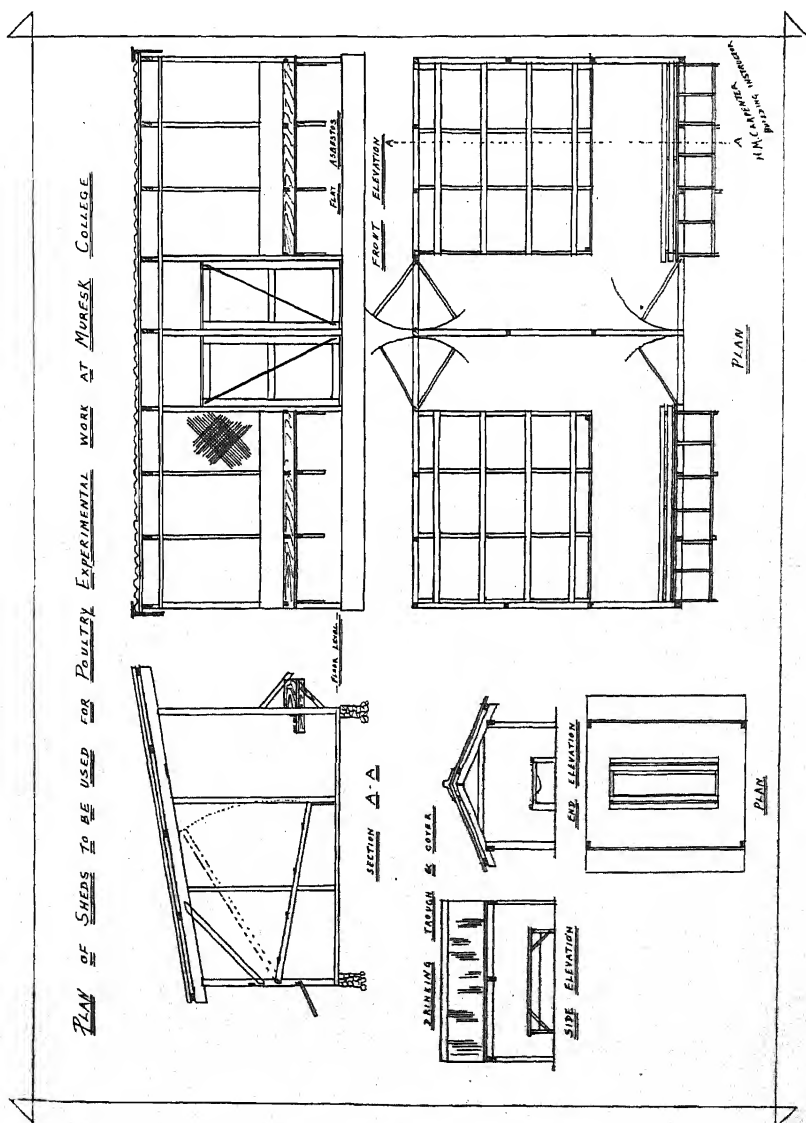


A close up of a shed with the watering system of Pen. No. 3 shown in the foreground. Each water trough is filled with a ball-cock and this type of watering system with accompanying shade covers has proved very successful during the summer just passed.

For the purpose three hundred Australorp and three hundred white leghorn pullets hatched in August-September, 1946, are semi-intensively housed in lots of fifty. The fowls in each pen have been selected as evenly as possible in regard to size, breeding quality and age and are appropriately leg banded.

The birds will be weighed at six monthly intervals and from time to time particulars of each pen, such as food consumed, number of first and second grade eggs laid and their value, (N.B. A first grade egg weighs two ounces or over) the profit over food cost, broodiness and the mortalities will be published in this Journal.

It is hoped that accompanying plans of the sheds and water troughs together with the photographs will give the reader a clear picture of the construction of these pens which house the experimental birds. The sheds are of corrugated asbestos, each shed being divided by a wire netting partition giving in all twelve houses which measures 12ft. x 12ft.



A plan of the sheds and water troughs.

Assistance to Importers of Pedigreed Stock.

FINANCIAL assistance on a substantial scale is now available to stock-breeders importing pedigreed stock from the United Kingdom, Canada or the United States.

A fund created by equal contributions from the State Government, the Commonwealth Government and the Commonwealth Bank provides for the payment of the following amounts in respect of approved stud stock:—

Cattle	..	..	..	£100	per head.
Draught Horses	..	..	..	£100	„
Pigs	..	..	..	£50	„
Sheep	..	..	..	£40	„
Milch Goats	..	..	..	£40	„
Poultry	..	..	..	£1 10 0	per head, or per setting of 16 eggs.

In addition to subsidy payments at the above rates, importers of cattle, sheep, milch goats and pigs from the United Kingdom will have the benefit of generous reductions in freight, shipping companies having agreed to carry approved stock at the following very low figures:—

Cattle	..	..	..	£50/8/-	(Stg.) net per head.
Sheep	..	..	..	£16/16/-	„ „ „ „
Milch Goats	..	..	..	£16/16/-	„ „ „ „
Pigs	..	..	..	£13/13/-	„ „ „ „

Stock-breeders who desire to avail themselves of the assistance offered should make application to the Department of Agriculture on the prescribed form which may be obtained direct from the Department or through a stock-broking firm. When the importation is approved advice is sent to the Commonwealth Veterinary Officer in London who issues a certificate to the shipping company concerned so that the reduced freight will be granted.

The importer must meet all costs in connection with the importation and should make application to the Department of Agriculture for payment of the subsidy after the animal has been safely landed and the provisions of the Quarantine Act complied with.

Payments will be made only in respect of animals for which a full certificate of registration by a recognised Stud Society is furnished together with the vendor's certificate of breeding and production record where applicable.

The scheme will also embrace importations by persons other than stock-breeders provided the stock imported is sold at an unreserved auction sale held within one month after the release of the animals from quarantine in Australia or within such extended time as may be approved by the Minister for Agriculture.

In this case the importer should make application for the intended importation to be included in the scheme, but the subsidy will be paid after auction to the stock-breeder who purchases for use in his own herd or flock.

A detailed statement of the conditions governing the scheme, together with application forms may be obtained from the Department of Agriculture, Perth.

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Banana Culture in Western Australia.

G. B. BARNETT, Tropical Adviser.

IT is intended that this article should cover the experience gained since the inception of the Gascoyne industry without, in any way, detracting from the value and helpfulness that must have been gained by the original settlers at Carnarvon from previous communications. At the same time, it is hoped that the following notes will assist new growers to avoid numerous pitfalls and also help present growers to increase the yield of fruit produced per acre per annum at reduced production costs.



Gascoyne River in flood.

The industry as a whole has enjoyed great prosperity during the war years, mainly through lack of competition on a bare market, and during this period of high prices, many of the finer points of production and especially preparation for market have been lost sight of. With the return to peace-time market conditions in sight, Gascoyne settlers must realise that in the not distant future competition on the metropolitan markets will have to be faced both from their old competitor Java and from the Eastern States. With a very substantial increase in production inevitable in New South Wales and Queensland, and the possibility of over-production and uneconomic prices, the industry in those States is searching for ways and means of reducing production costs, improving transport and ripening methods and the expansion of their markets. Already it has been seen what effect good Eastern States bananas can have upon our lower grade lines and that, providing the W.A. product is good, it can withstand serious competition. It is quite obvious therefore, that prices realised over the past few years cannot be maintained and the W.A. industry like the Eastern States, must strive for better yields at more economic cost and the forwarding to the consumer only the best in the best condition. While the individual grower is responsible to himself alone for the production of good quality fruit and while it is not suggested that he should extend his individual activities beyond the production point, nevertheless it is the responsibility of banana growers collectively, to see that improved transport, ripening and marketing facilities are attained wherever possible. Remember the consumer is your master who demands a good quality product, i.e., a banana with appearance, flavour and keeping qualities. This can only be achieved through good farming, good transport and the highest standard of ripening methods.

Soil.

While there are approximately 4,000 acres within the settlement area, not all this land is suitable for banana culture. Generally speaking, the best land is in close proximity to the banks of the river, this being of brown micaceous loamy sands, and sandy loam layers, generally calcareous in the subsoil.

Owing to the low average rainfall (9 inches) the nitrogen accumulation is low and Dr. Teakle's work ("Terraced Soils of the Gascoyne River at Carnarvon") classes the soil as being poor to medium in nitrogen and organic matter, medium to normal with respect to phosphates and good to rich in potash. The fact that the soils lack nitrogen indicates very strongly the desirability of building up the organic matter in the land as soon as it is cleared, and this can be achieved by the growing of green crops and the turning in of liberal quantities of acacia leaves (hundreds of tons of which are available to the energetic grower), and sheep manure.

Behind this tract of land on some locations are soils of a heavier and stiffer nature which, while in the virgin state, are too heavy for successful banana culture. If given correct treatment there is little reason why these areas should not be brought under production.

Vegetation.

The native vegetation on these soils comprises mostly thickets of wattles (*acacia* spp) interspersed with salt bushes (*atriplex* spp and *Rhagodia* spp), stunted gums (*Eucalyptus rostrata*) and seasonal grasses and herbage plants. (Fig. 1.)

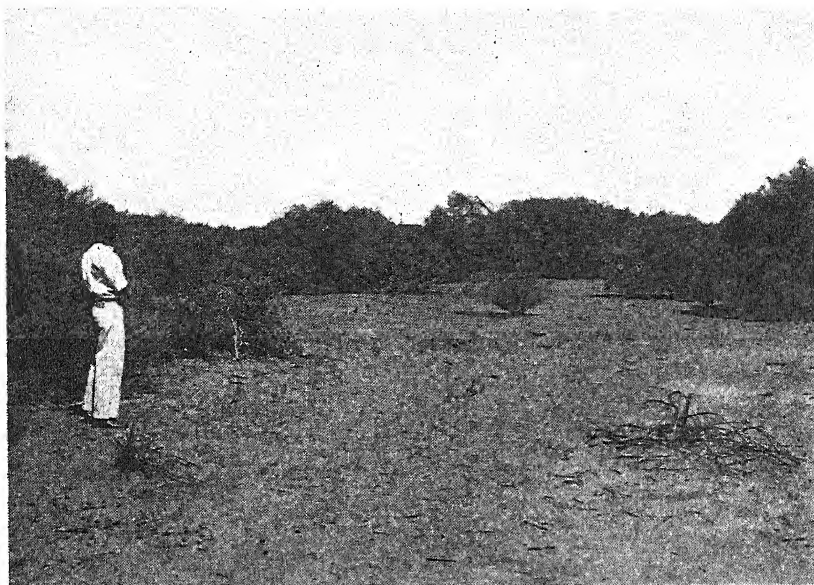


Fig. 1.—Typical banana land in its virgin state.

Water.

The annual rainfall is of such a scattered nature as not to be relied upon, and irrigation practices are adopted throughout the whole of the year. Each settler possesses his own irrigation unit and, wherever possible, this is installed on the riverbank and the water drawn from the river sands which are approximately 20 feet deep. In many instances, growers have been successful in locating an additional water supply after boring through the river clay bed to a depth of 30 to 40 feet, but the quality of these waters, in some instances, varies with the seasons. This underground supply rises to the level of the water in the river sands. The quality of the river water is good, the principal salt is sodium chloride (12 grains per gallon) and a considerable proportion of calcium. The average irrigation unit consists of a 10 h.p. Diesel engine, 2½ inch to 3 inch centrifugal pump, (Fig. 2); 3 inch suction and delivery pipe line and 3 foot 6 inch diameter cement cylinder or well—delivering 8,000 to 10,000 gallons per hour. The engine and pump unit is the most valuable asset the grower possesses for if this is not operating satisfactorily his livelihood is in jeopardy, therefore this outfit should be properly housed, regularly serviced and thoroughly overhauled each winter. Where it is necessary for settlers to obtain water supplies other than from the river sands, it is advisable before erecting pumping equipment on the site, to submit samples to the local office of the Department of Agriculture for analyses.

This procedure is recommended at all times if a grower is in doubt as to the salinity of his irrigation waters.

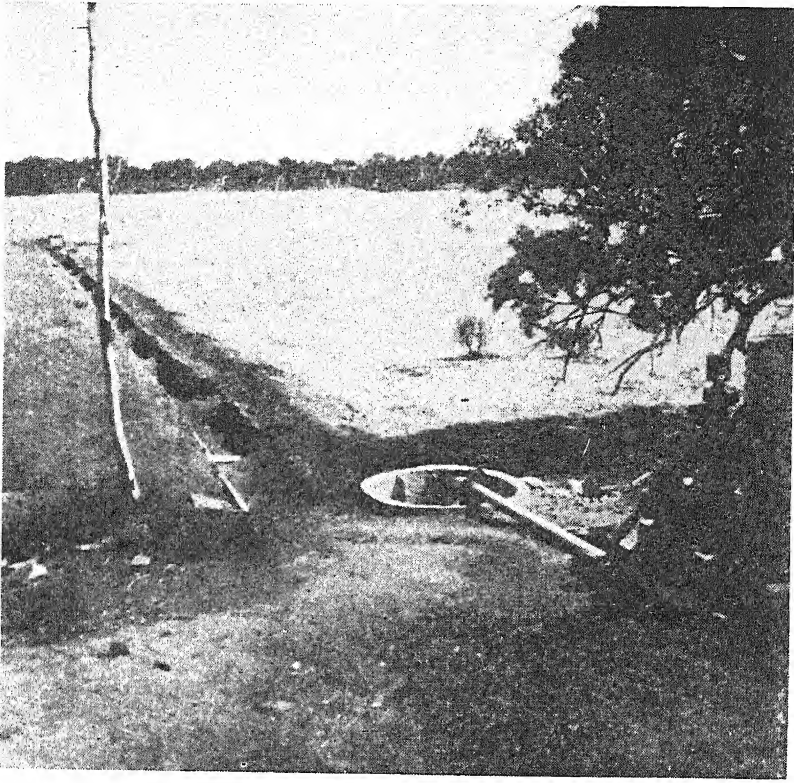


Fig. 2A.—View of irrigation unit showing from right to left: The engine, delivery line, pump well, suction line and, upper left, the 3ft. 6in. diameter cement cylinder in river sands.

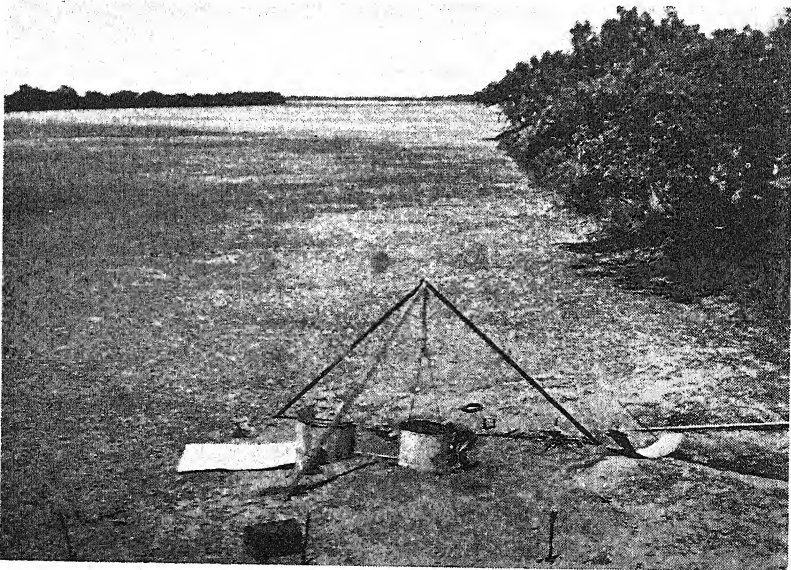


Fig. 2B.—First stage of well under construction in bed of river. The sands are



Fig. 2C.—Second stage. Using a sand pump to lower cylinder down to water in river sands.



Fig 3.—Typical Gascoyne banana land after ploughing.

Preparation of Land.

For best results, the greater part of land preparation should be carried out one year prior to planting time. That is, the land should be cleared (all major roots grubbed), graded and ploughed as deeply as possible. (Figs. 3 and 4.) Severe grading should be avoided and it is better to make the plant rows conform to the natural contour of the land. Plant rows should be struck out and cover crops planted. Suitable summer cover crops are Poona Pea, Jerusalem Pea, (Rice bean), Pigeon Pea, Crotalaria, Mauritius Bean, Cow Pea or Soya Bean, while New Zealand and Blue Lupins or Gray Field Peas produce a heavy tonnage of green matter during the winter months. These crops should be ploughed in as soon as maximum growth (the flowering stage) has been reached. Following the ploughing in of a leguminous crop it is advantageous to grow a crop of barley, oats, or other straw crop.

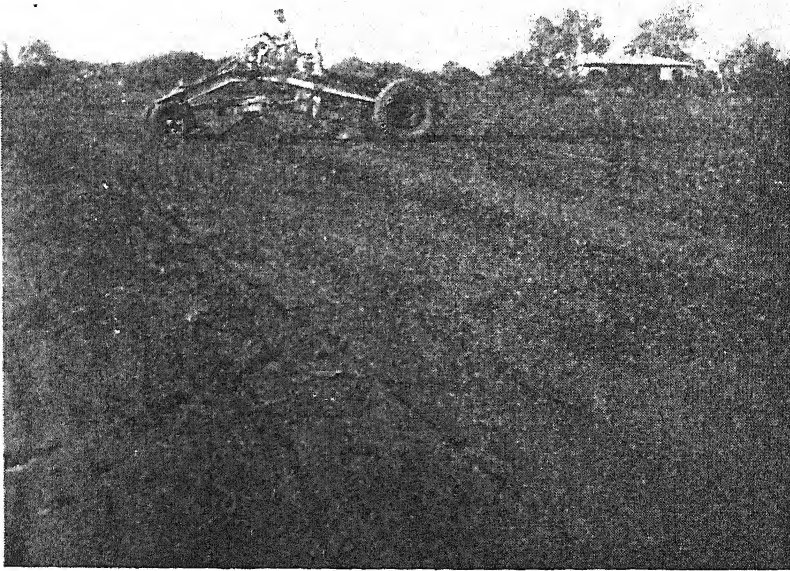


Fig. 4.—Grading the land with power grader.

Windbreaks.

As Carnarvon is notoriously windy (there are claims that it is windiest location in the southern hemisphere) windbreaks are essential for contracting the almost continuous south-westerly winds, and the occasional hot dry easterlies in the summer. These breaks should be erected or planted in sufficient time to insure their establishment for maximum efficiency by protecting the young banana plants as soon as they commence to flag.

Many and varied have been the types of windbreaks tested around plantations, but little attention has been paid to the establishment of permanent wind protection.

For efficiency a windbreak cannot be too high, but it can lose its effectiveness if too dense. A dense windbreak affords protection for plant life in close proximity for it causes wind to be deflected upwards, but the pressure of air current behind this deflected air stream forces it onwards and downwards with the result that plant life further away from the break appears to suffer more severely than if the direct wind force was passing along its natural course.

Seven year Bean, or Poor Man's Bean, has been used a great deal in the past, but was discarded owing to nematode infestation, and its competitive root system with the banana. North Coast or Wooramel Creeper (*Momordica balsamina*) (Fig. 5) used in the same manner as the seven year Bean has proven less detrimental, but is a harbour for rats, orange piercing moth and other pests. Such types of breaks are temporary and costly when posts, wires, brush and labour costs are considered. The most popular break at present is the Plantain (*Musa paradisiaca*) (Fig. 6) having in its favour speed of growth, height, similarity of growth to the crop it is protecting, while growing dense it is not too dense and appears to mince the oncoming wind. During dead calm summer days air currents are able to pass to and fro.



Fig. 5.—Windbreak of Wooramel Creeper.

The Plantain also has a value in that it produces a crop of some commercial value. Despite the advantages of this plant it is, after all, of a temporary nature and more attention should be paid to permanent breaks. The River Gum, Mesquite, Carob Bean, Pines and Mango are worthy of consideration. A break of dense topped trees intermixed with taller topped forms, makes an irregular and more satisfactory shelter than one of uniformly tall dense trees.

Where Plantains are used for a break it is recommended that the suckers be planted stagger fashion along the row at a distance of 4 to 5 feet apart. Owing to their height, they should be planted about 12-15 feet from the first row of bananas.



Fig. 6.—Windbreak of Plantains.



Fig. 7A.—Spillpool. This is a 5ft. deep and 3ft. 6in. diameter cement cylinder with the water entering from the delivery line near the bottom of the cylinder.

Layout of Plantation.

The layout of the plantation should be so planned to achieve compactness of first and consecutive plantings, to enable quick, frequent, and economic irrigations. To achieve this impervious drains are very desirable from the spill-pool (Fig. 7A) to the gates or stops at the head of the banana rows; each subsidiary drain should be so built to enable water to be delivered to banana rows from each side of the drain. (Fig. 7C.)

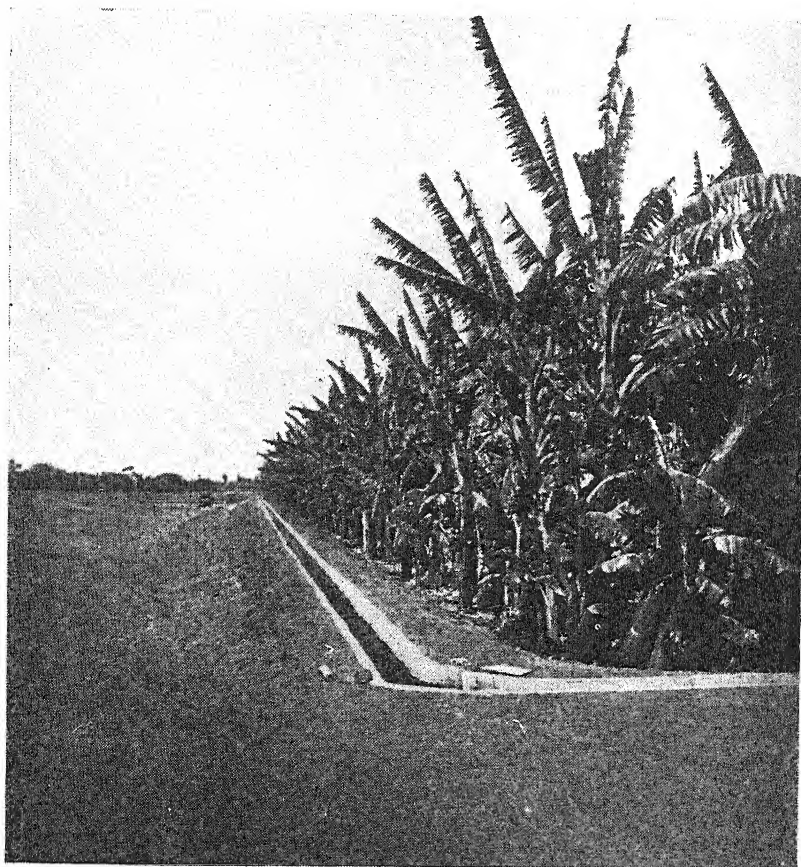


Fig. 7B.—Main drain and Plaintain windbreak.

Care should be taken when erecting the cement drains to insure sufficient height of the gate or inlet above the banana rows, for the banana basin or irrigation row gradually silts up, and in a few years difficulty will be experienced in pushing the water flow down the banana rows. Careful attention should also be given to the spill-way at the inlets to the banana rows so that scouring of the soil does not take place that will weaken the main drain foundations. The spill-way from the drain to the banana row should be so constructed that the water upon leaving the inlet will immediately drop to the level of the surface soil in the banana row. Make sure the stops or outlets are large enough to permit the easy flow of the maximum amount of water likely to be ever available.

The banana rows should be short in length, 3 to 4 chains being quite sufficient. Short rows eliminate a considerable amount of grading, enable quick and frequent waterings, this being not only of advantage to bananas, but is of considerable value in the event of prolonged heat waves, mechanical breakdowns in the irrigation unit, shortage of water supplies. The value of short rows is also appreciated when carrying out bunches at harvesting time, when manuring, or carrying out most cultural operations.

It is advantageous to have a slight grade to the banana row in preference to making the rows perfectly level. Difficulty is likely to be experienced with level rows when irrigating after the first year, by trash lying on the soil surface retarding the flow of water down the banana rows. All grading operations should be completed before planting out and it is much better to make a late season planting in preference to attempting to complete grading after planting.



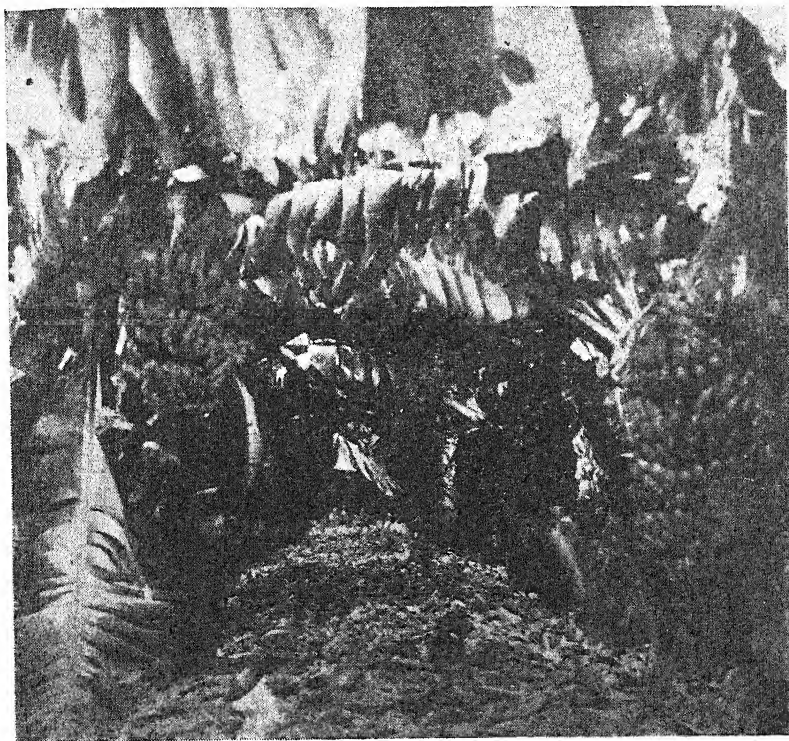
Fig. 7C.—Subsidiary irrigation drain with spillways to banana rows. Note drain elevated above banana rows but bottom of spillways level with banana rows.

Planting Distance.

Included with the layout of drains and length of rows, the system of plant rows, distance between rows and plants should be given full consideration. Distance apart of rows and plants will always raise a controversy, while wide rows and plants in rows, say 12 feet by 12 feet, have many advantages, this system

is largely defeated under Gascoyne conditions by exposure of plants to winds and heat. An ideal distance appears to be 10 feet by 10 feet (11 feet by 11 feet for tall varieties), thus enabling early protection from wind and heat, but possibly reducing the life of the plantation by a small degree. Under Gascoyne conditions it is advantageous to practise concentrated farming principles as much as possible, and close planting of crops will tend to increase humid conditions which are so desirable for the success of tropical crops. In order to arrive at the number of plants required to plant an acre of land the following method is adopted:—

Reduce one acre to sq. feet = 43,560 sq. feet: divide this by the square of the distance apart at which the suckers are to be planted.



Looking along rows of a well developed Cavendish plantation

Plant Rows.

Preparation of plant rows will depend upon equipment available to the individual settler. In the past, the camel and horse have eliminated much laborious hand labour, but with the advent of tractors and other power implements to the settlement, this work can be further facilitated and more economically carried out. Illustrations on pages 84, 90 and 102, depict some of the methods used by settlers and each has its advantages and disadvantages.

After the general ploughing, cross ploughing and levelling has been completed, the plant rows should be laid out. (Fig. 8.) Along the plant rows the plough should be travelled several times, setting the plough as deeply as possible. The rows should then be opened out with a double mouldboard (Fig. 8), or other such implement to a width of three to four feet, and the plough again travelled

up and down the newly made basis to as great a depth as possible. By this method it is possible to disturb the soil to a depth of two to three feet and will greatly eliminate the necessity of digging plant holes.

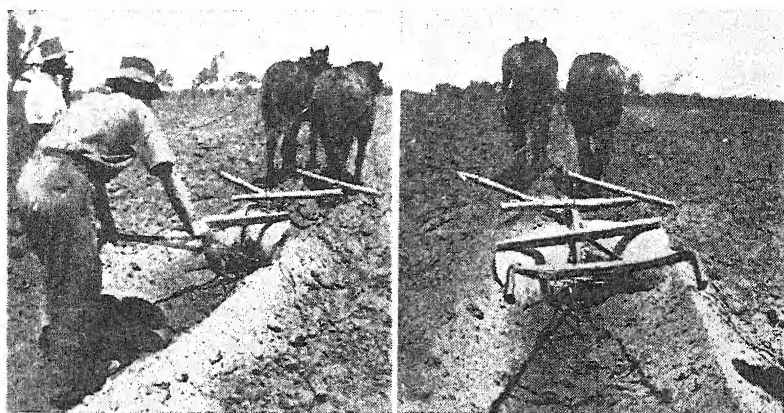


Fig. 8.—Opening plant row with double mouldboard plough.

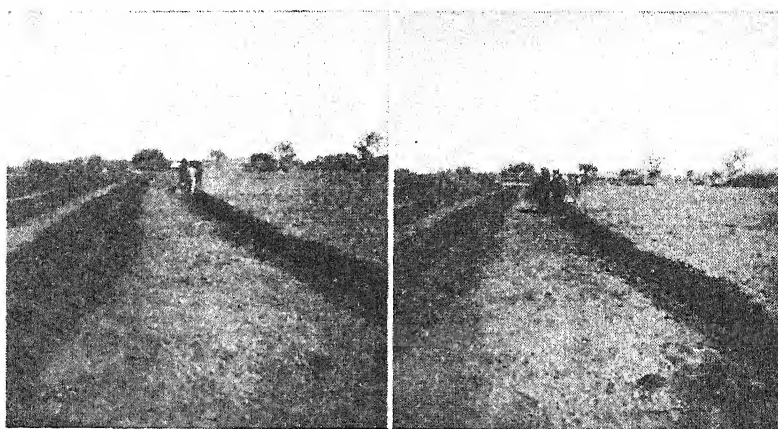


Fig. 8A.—Opening banana rows with mouldboard plough.

It is recommended that liberal supplies of acacia leaves or sheep manure be broadcast along the plant rows prior to making the final deep ploughing.

If mechanical means are not available for the laying out of plant rows it will be necessary for the grower to dig holes. These should be approximately two feet deep and three feet wide—the wider the better—the top 12 inches of soil should be kept aside and returned to the bottom of the hole in which should be incorporated one or two tins of acacia leaves. It is important to well mix the acacia leaves with the soil.

Tillage of the soil is one of the most important factors entering into the production of good bananas, and success depends to a considerable extent upon the thoroughness of preparation given the soil before planting. As previously stated, this preparation of the land should be carried out a year ahead of planting, and once the above work is complete, cover crops should be encouraged.

Planting.

Just prior to planting the land should be irrigated, the plant row or holes should be cultivated and if the land is carrying a cover crop, as much as possible should be turned into the ground.

Depth of planting will vary with the type of propagation material being used, but as a general rule the bottom of the plant should be about 15 to 20 inches below the surface of the trench basin or hole, this depending upon the type of propagation material used, and should be covered with eight to 12 inches of soil.

If the land has been properly prepared, it is only necessary to dig out sufficient soil to enable the plant to be placed in position. After planting gently press the soil around the plant, *but do not completely refill the hole with soil.* By leaving a good depression around the young plant, a small stream of water may be used during the early stages of the plant's growth, instead of having to flood the entire plant row.

Many growers apply about 1 lb. of blood and bone to the plant hole at planting time, but providing the previously suggested ideas of soil preparation, acacia leaves and green crops, have been adopted, it would be more economical to withhold this manure until the plant has made several months' growth.

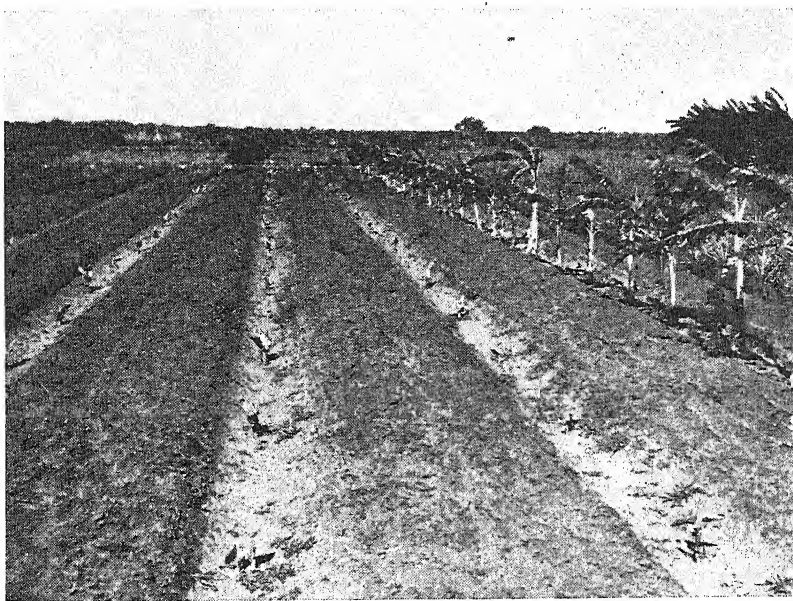


Fig. 9.—Plant rows with young banana plants. These plant rows or basins are periodically widened, eventually to about 8 feet. See Fig. 14.

Early Irrigation.

It is advisable to refrain from irrigating the young plantation until vegetative growth has shown above the surface soil. This is particularly advisable where small suckers are being used as propagation material, owing to the risk of rotting through too moist a condition during the heat of the day. Even after germination has commenced, it is recommended that irrigation during the first few weeks should be avoided during the heat of the day.

Once the plant is well established the basin or trench can be gradually widened. (Fig. 14.) The soil removed in the widening of the rows is spread in the trench or basin thus raising the level of the plant row, and increasing the depth of the plant in the soil.

In the basin method, this widening can be done with the plough.



Planting butts.

PROPAGATION MATERIAL.

It is increasingly realised that to improve the standard of crops it is necessary to select from strong, robust, heavy and good quality producing stock. When selecting bananas for propagation not only the parentage but the progeny itself must be considered because of the all important part it plays in the ultimate success of the plantation, and with the heavy initial outlay for the grower in this State compared to other parts of the Commonwealth, it is necessary to procure the best planting material possible both to ensure early and profitable returns and enhance the disease-resisting qualities of the plantation. It will be agreed that the planting of inferior banana stock will result in the plantation producing low grade bunches and poor quality fruit, but many experienced growers do not realise the necessity for the observation of more exacting details when selecting propagation material and the early attention some types of plants require.

Suitable Material.

Various parts of the banana plant may be utilised for propagation purposes, such as suckers, corms, butts, bits or eyes. At the present time in this State suckers are practically the only planting material available, and it is intended that these notes should deal more especially with the selection of this particular type of planting material. Before doing so mention might be made of the usage of corms, butts and bits or eyes. The opportunity of obtaining these types of

planting material is likely to be scorned by the new or inexperienced grower as being unsuitable, but good types of butts or pieces may give as good results as suckers providing they are properly handled before and after planting.

Butts (see page 92, "Planting butts") are generally obtainable from old or well established plantations which have become unprofitable. There are two types of butts, viz., the one that is secured from a growing plant and the one that is taken from a plant that has produced a bunch. The former type is the more desirable as it usually produces a better first bunch. The usual custom when selling butts is to divide the butt into two or more pieces—the cutting into sections or pieces being so performed that each piece possesses one or more strong eyes. Butts may also be planted whole but it is advisable to destroy all but one or two of the strongest eyes. (The surplus eyes can be destroyed by gouging from the corm prior to planting.) Good butts prove excellent for use as refills within the established plantation, thriving better than any other propagation material for this purpose.

When planting pieces or bits the cut surface should be turned uppermost, and therefore the eye or uncut surface will be in the bottom of the hole. Pieces usually take a little longer to come into bearing than is the case with butts. The use of eyes or bits cannot be entirely recommended for the Gascoyne district as they are liable to dry out very quickly and may possibly decay under irrigation. After subdividing the corms it is well to permit the cut surfaces to dry out a little prior to planting.

In the selection of suckers the intending grower should observe the vegetative growth, the producing qualities and the freedom from disease of the plant within the plantation from which he intends securing his plants. It is conceded that if the plantation is healthy, vigorous and producing good quality fruit the progeny should reproduce on similar lines.

Generally speaking the average plantation is considered to be in its prime between the age of three to six years, but it is suggested that growers take this as a guide only, for some plantations of less mature age may more than favourably compare with plantations between the ages mentioned.

One-Year-Old Stools.

The selection of suckers from one-year-old plantations is much to be discouraged, not only because of the inferior quality planting material available (Figs. 12a and 13) but the damage that may be done to the parent plant bearing or about to throw its bunch. Suckers selected from year-old plants cannot be expected to compare with suckers from a three-year-old stool (Fig. 11), as the year-old plant must necessarily be producing offsprings of tender growth which are only good quality plants in the making. No doubt there are exceptions, but when the damage likely to occur to the parent by the removal of suitable planting material is considered the wise grower will realise that the saving in the cost of plants or the money gained by the sale of such suckers will not recompense him for the damage to the young parent and developing bunch. The sucker being tender is likely to give poor planting results should adverse weather conditions be experienced, but should the grower find it necessary to use such material in establishing his plantation he should arrange for the planting to be carried out as quickly as possible after the removal of the sucker from the parent plant. Additional care should be taken during the removal of the sucker from the parent both from the viewpoint of the young parent and tender offshoot.

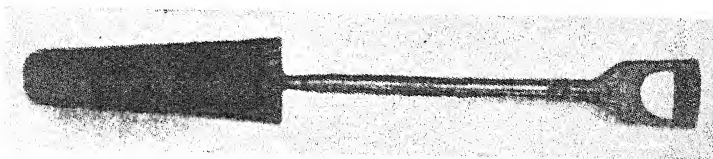
Fig. 12a depicts six suckers taken from a one-year-old plantation, and only E and F are fairly suitable plants for propagation purposes. Note the area that had to be severed from the side of the parent to permit the removal of suckers E and F.

Taking the well developed plantation as the grower's best guide, the best type of sucker to select must be considered. Opinions vary even amongst experienced growers as to the stage suckers should reach before removal for transplanting. The fact is generally acknowledged that the later in the spring suckers are removed the better, but it must not be forgotten that the plant or sucker planted late may have to commence its new life under rather severe climatic conditions on the Gascoyne. Suckers six to eight months old are favoured by some growers, their method being to eliminate the centre growth and allow the first followers to produce the first bunch. When using this type of plant, if this practice is not adopted, the grower may anticipate an early bunch of rather inferior fruit compared to the bunch that would be carried by the first follower were the original centre growth destroyed.

The size of the sucker is not a true guide to quality for the rapidity of growth of suckers varies tremendously. The main points to keep in mind are that plants should possess good solid bulb formation with the pseudostem or barrel of the plant a maroon or dark brown colour and tapering from the bulb to the apex, the leaves growing fairly upright being small and narrow; such type suckers are commonly known as "spear points" or "sword" suckers. Strictly avoid suckers with small bulbs possessing barrels of more or less even girth from bulb to apex, with broad spreading leaves. These are known as "umbrella" or "water" suckers and are slow developing plants producing inferior bunches. Fig. 11 describes good type spear points or sword suckers removed from three-year-old stools and are far superior to all suckers in Figs. 12 and 13.

Removing the Sucker.

The utmost care should be taken during the operation of removing the sucker from the stool both for the good of the sucker and parent plant. The mattock, shovel or hoe are not very satisfactory tools for severing the sucker, and the operator should use a suitable bar, similar to a crowbar, the blade of which should be long, flat and wide and possessed of a sharp edge. For convenience of working the blade portion of the bar may be set at an angle to the main shaft of the instrument, the whole implement being of sufficient weight to give a good fall.



A draining spade is also a very useful tool for removing suckers.

The soil should be removed from between the parent plant and sucker so that the operator can detect the union of the two plants. The bar is then placed at the narrowest part of the union and forced downwards. With large suckers it is necessary to remove soil from both sides before attempting the removal, and it may be found necessary to aim the bar at the point of union of the two plants. Never attempt to remove plants that are wedged between two adult plants,

for not only is the young plant likely to be damaged, but considerable root surface on the adult plants will be destroyed. The entire operation should be one of gentleness—no more force than necessary should be used when loosening the sucker. With the most careful and methodical operator there is likely to be a percentage of damaged suckers and these should be discarded. The honest vendor will not supply damaged or otherwise unsuitable plants that he himself would not plant.

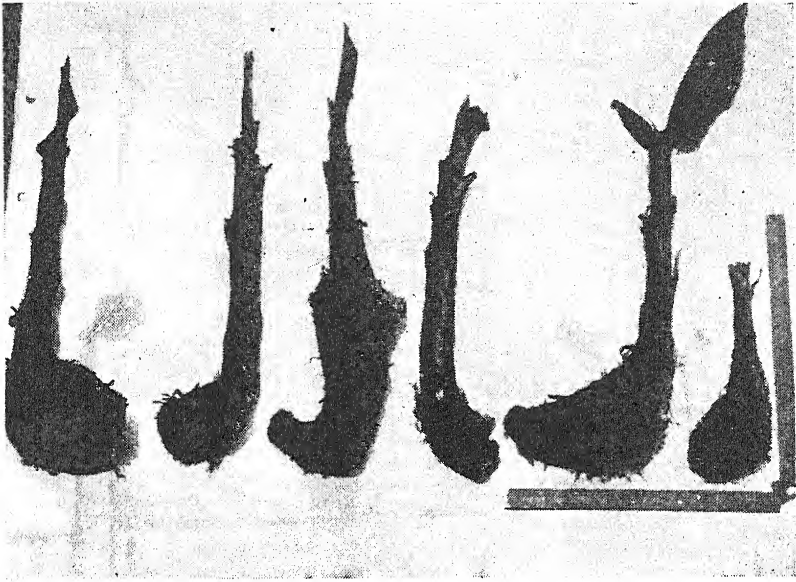


Fig. 10.—Inferior type plants from declining or run out plantation, unsuitable for planting.

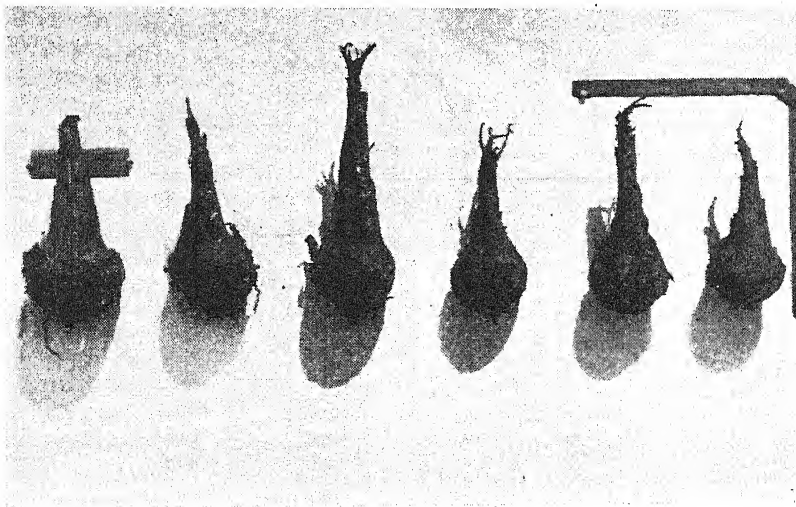


Fig. 11.—Depicting good type spear points. Note size of corm and tapering top.

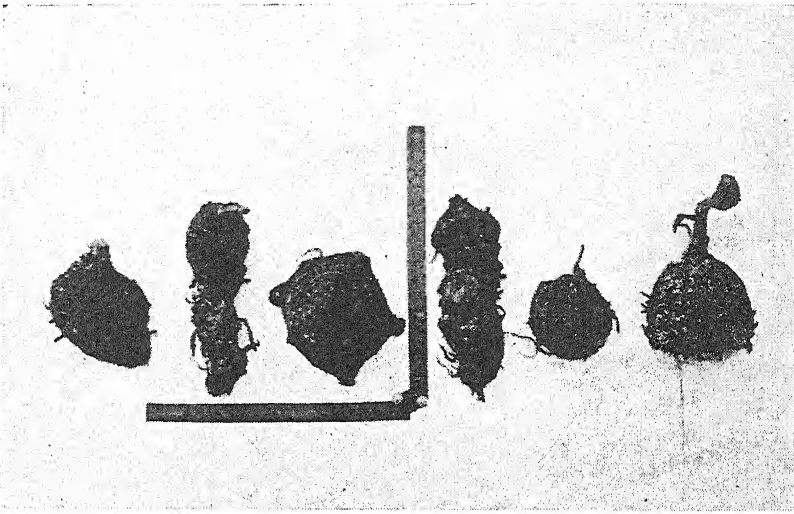
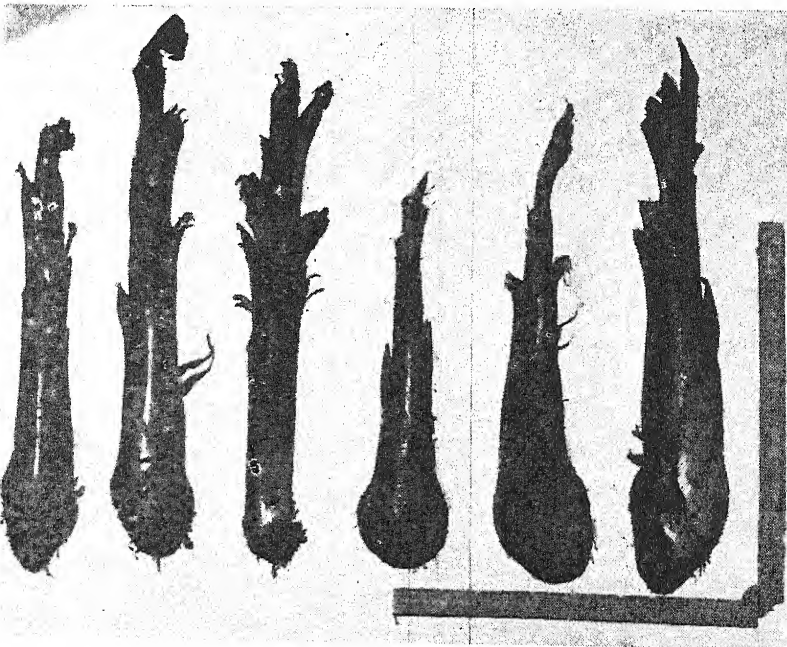


Fig. 12.—Inferior type plants that should never be used. Note corky rings around shoulder of corms.



A B C D E F
Fig. 12A.—Suckers from one year old plantation.

After Removal.

All leaves should be removed to minimise transpiration and all roots cut off close to the bulb or corm. With large plants it is advisable to cut back the top portion of the barrel to within about eight inches of the crown of the bulb in

preference to only removing the leaves. The cut should be made on the slant and high enough up on the stem so that when the sucker is planted the irrigation water will not cover the cut surface (this point relates more particularly to late planting). Where suckers as depicted in the centre plant of Fig. 13 are being used as planting material it is optional to remove any of the top growth. As a precaution against fungal infection of the sucker after removal from the stool the cut surface of the plant may be turned to the sunlight for several days when the sappy surface will harden and thus reduce the possibility of corm trouble. This precautionary measure should also be adopted with cut up butts but is not recommended in the case of suckers from year-old plants. The habit of certain growers of rubbing the freshly cut surface of the sucker or bits in the soil is a bad one, as this action is liable to introduce soil fungi and bacteria which may mean decay of the corm early in the life of the young plant.

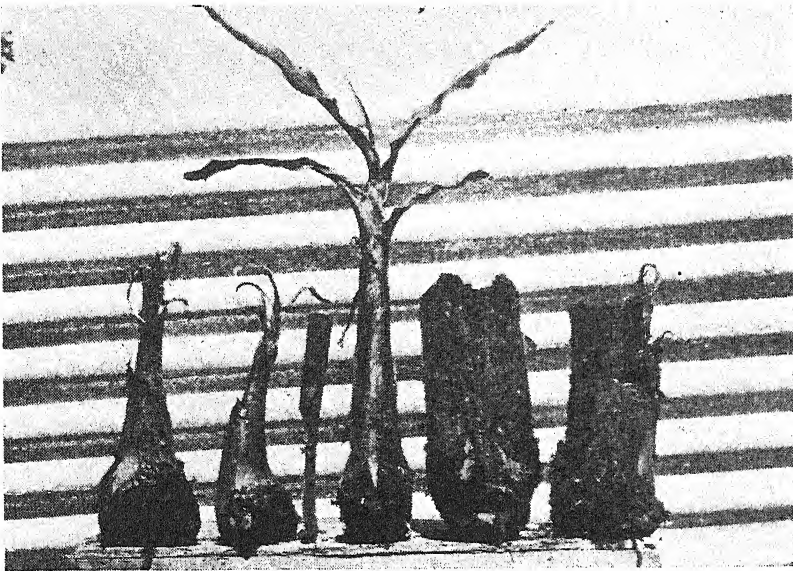


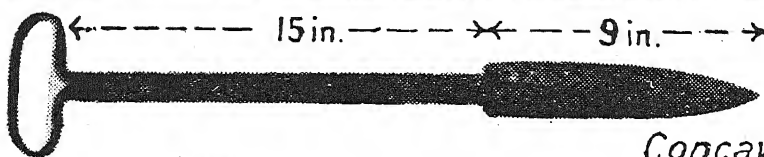
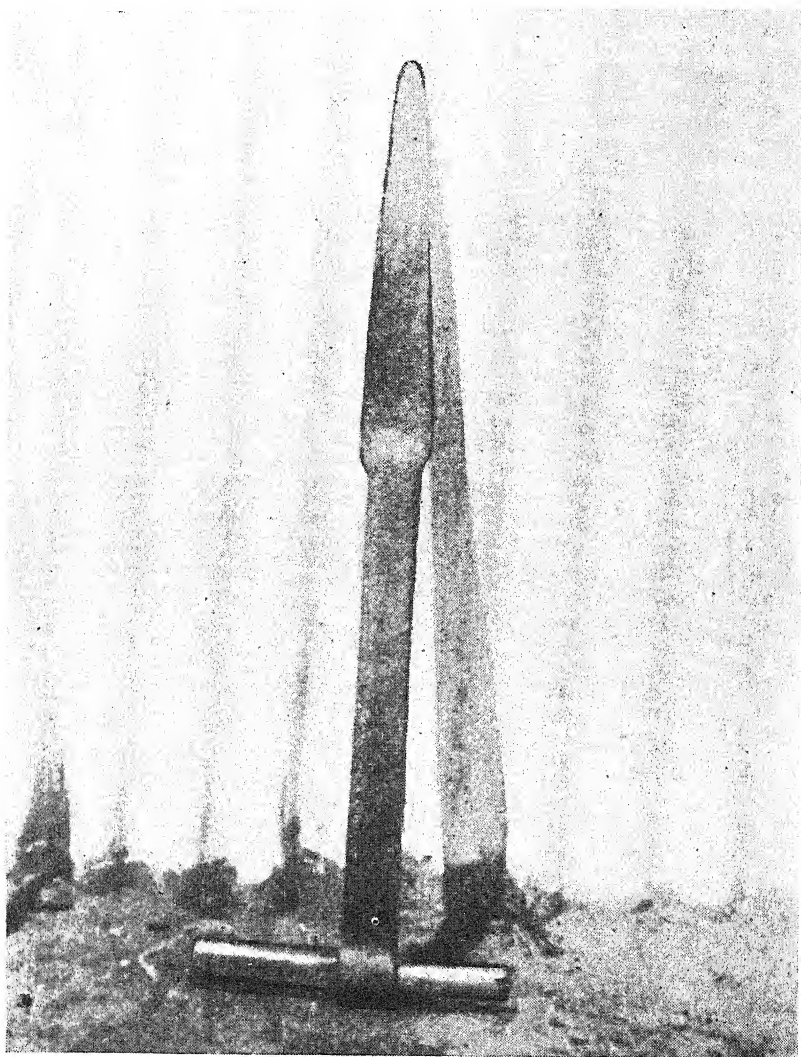
Fig. 13.—Material from vigorous one year old plantations removed late in planting season. These have a tendency to be soft and require immediate planting after removal. Not recommended for Gascoyne conditions.

All propagation material should be free of all soil and roots prior to removal to the intended planting ground. This precaution is necessary so that disease and pests which harbour in and about the corm may be detected. If plants are being used from an old plantation or one heavily infested by nematode or eel-worm it is advisable after cleaning the plants, to dip for an hour in corrosive sublimate (1 oz. to 6 gls. water). Care should be exercised in using this material as it is a powerful caustic agent and very poisonous.

Plants with prominent brown corky rings around the shoulder or top of the corm should never be used as these rings usually indicate aged or stunted growth. (Fig. 12.) No doubt this type of plant will grow but will produce an inferior bunch and followers.

Bulbs or corms which show decay or reddish brown strands on the interior should be discarded. The slogan "if in doubt throw it out" is worth while.

In other banana producing countries the grower adopts the term of "so many acres of bananas" but in W.A. it is customary to speak of so many thousand plants. Possibly this is a very wise method of describing an area of bananas, for it tends to indicate so many "producing units," the grower possesses. After all, each plant or each stool should be made to produce to the maximum. A poor or weak plant takes just as much manure, just as much water and attention as a good vigorous plant, but does not return in £ s. d. a corresponding amount of revenue, so start right by planting right.



"Banana gauge" or "de-suckering bar."

De-Suckering.

The pruning or reducing of surplus sucker growth from around the plant or stool is necessary if large marketable bunches of fruit are required. With this object in view the grower must formulate some method whereby this work can be carried out most efficiently. The entire digging out of the surplus suckers is not recommended as to do so necessitates the destruction or damage of much root surface on the remaining plants, which naturally must have a detrimental effect on the forthcoming bunch. The work can be most successfully carried out by the use of what is termed a "banana gouge" or "de-suckering bar." By the use of this implement the growing point of surplus suckers can be destroyed without in any way disturbing the root system of the parent plant. This operation is best or most easily carried out when the surplus suckers are about one foot high; if the suckers are allowed to develop to a more mature age the work of de-suckering is increased and in the meantime, unnecessary sapping of plant food is occurring.

The plant to be removed should be cut off at ground level with a sharp knife. The point of the gouge is then inserted just inside the outer edge of the base of the plant and with a little pressure and turning of the handle in an auger-like fashion the heart of the corm or bulb can be lifted out. The heart of the corm can be detected by the close white-grained tissue compared with the other parts of the corm. Until the operator has become accustomed to detecting the heart section, it is suggested that he gouge right through the corm into the soil, when he will be satisfied that the vital portion has been destroyed.

Stooling.

The number of suckers that should be left around a stool depends upon such factors as the age and condition of the plantation, distance apart of stools, soil conditions, etc. In the case of a year-old stool no more than three followers of various ages should be allowed, and these should be so located that each one is as far apart as possible around the stool (see page 100). In the regulation of suckers around a well developed stool, the main object should be to select offshoots of varying age so that not all plants are maturing their bunches at the same time. Three adult plants with three followers is quite sufficient growth to allow to remain if large bunches are required. Eliminate suckers that develop between the adult plants or in the centre of the stool as these suckers will seldom produce commercial bunches. The type of offshoot to leave can be selected on the same points that have already been mentioned when selecting propagation material.

In selecting the most suitable suckers as followers, endeavour to retain the suckers that develop well away from the parent. Not only will it be found that these usually produce faster and better bunches than suckers developed close to the parent, but as the former develop or shoot from eyes low down on the parent corm, they are naturally deep rooted and therefore, assist to prolong the life of the plantation, which often becomes unprofitable not on account of soil poverty, but on account of the plants rising to the surface and falling over in light winds following upon irrigating. Each generation of plants should be formed from the generation immediately before it, i.e., avoid leaving two followers from the parent plant.

Irrigation.

No set rules have been laid down for irrigation practices and applications of water must be judiciously handled by the individual grower according to the type of soil, the system of planting, layout, length of rows and amount of

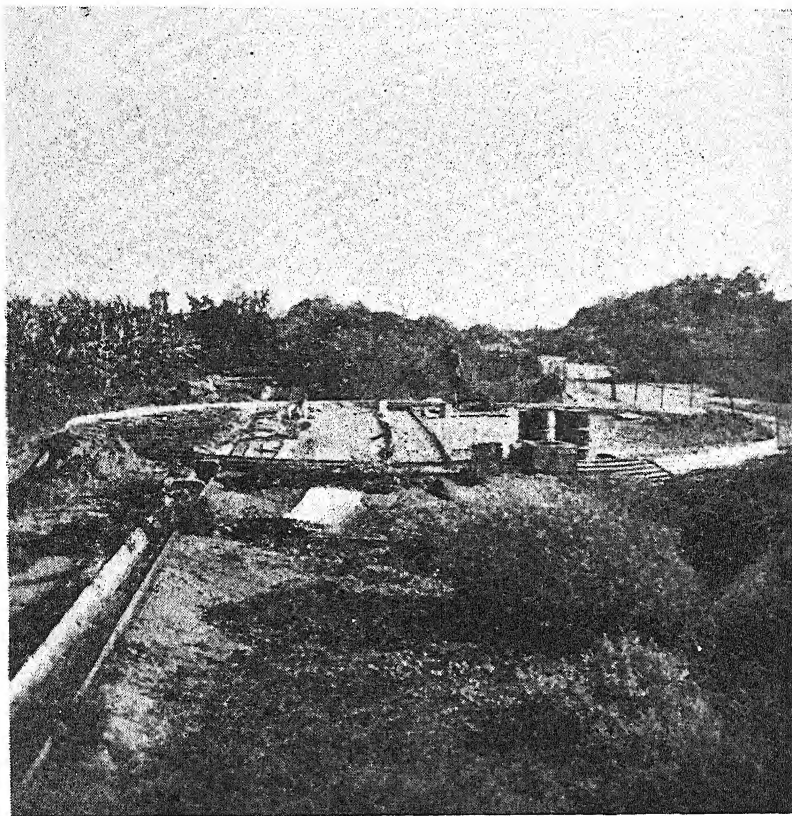
water available. The general practice is to irrigate every week in the summer, and every fortnight in winter. Should severe heat be experienced, it is necessary to apply water more often during the summer months. It behoves the grower to have a unit and plantation layout that will enable him to irrigate his entire area in less than a week, and so not only avoid being continually tied down to



One year old plant showing correct spacing of the following suckers of various ages.

his property seven days a week with irrigation duties, but to enable a quick return of irrigation waters in the event of heat waves or after mechanical trouble in his pumping unit.

An irrigation should be applied to the plantation as soon as possible after manuring or the removal of suckers for planting.



Sixty thousand gallon ground surface storage tank under construction.

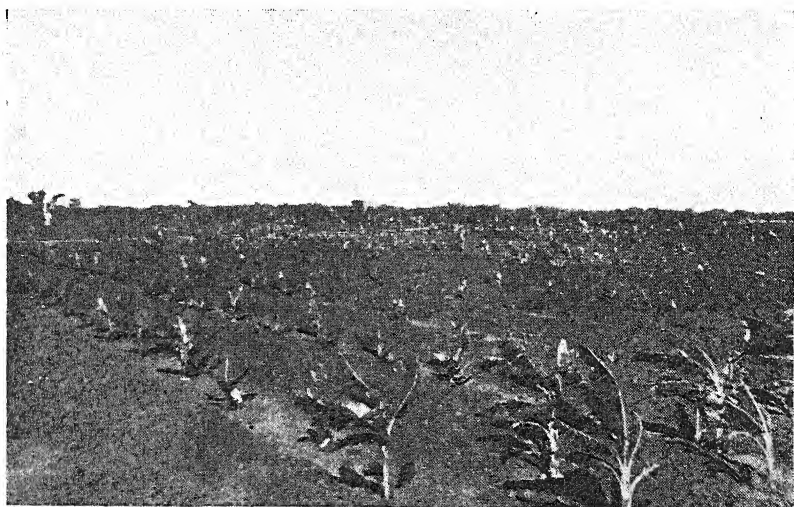
If finances will permit, the grower should have more than one irrigation unit, and keep on hand essential spare parts for his pumping unit. Some growers have erected 40,000-60,000 gallon tanks built on the ground level, and these appear to be a good investment in that they permit a useful storage and head of water, which can be built up after the close of the day's labour in the plantation.

At the moment, considerable interest is developing into the possibilities of "overhead irrigation" and already several growers have installed small units. While this system would eliminate considerable preliminary work and cost in the laying out of a plantation, the initial cost of the system is heavy. Overhead irrigation trials are being initiated at the Tropical Research Station and growers are advised to await these investigations before expending any money on this system. It must be remembered that the low rainfall and sharp dry atmosphere

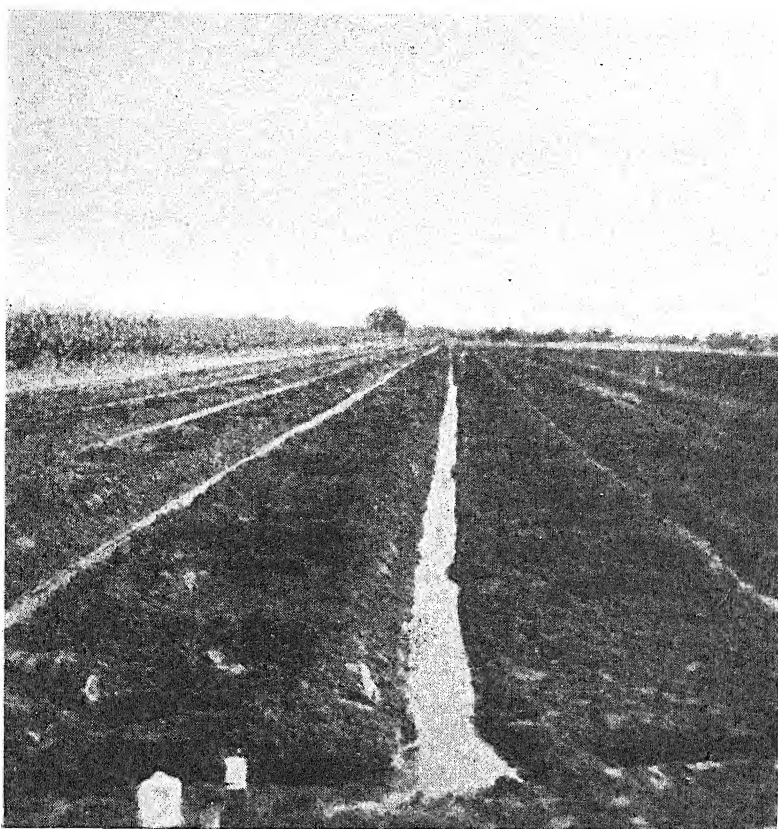
of the Gascoyne has many benefits for the banana grower, especially in the suppressing or keeping under control of many foliage and fruit disease which might otherwise develop under more humid or wet conditions particularly during the cooler months of the year.



Ploughing typical Carnarvon banana land.



Easin method of planting and irrigating.



Furrow and hole method of irrigating.

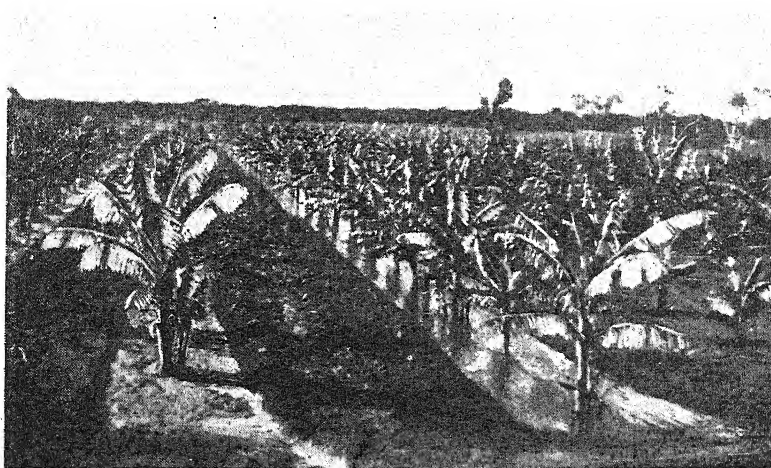
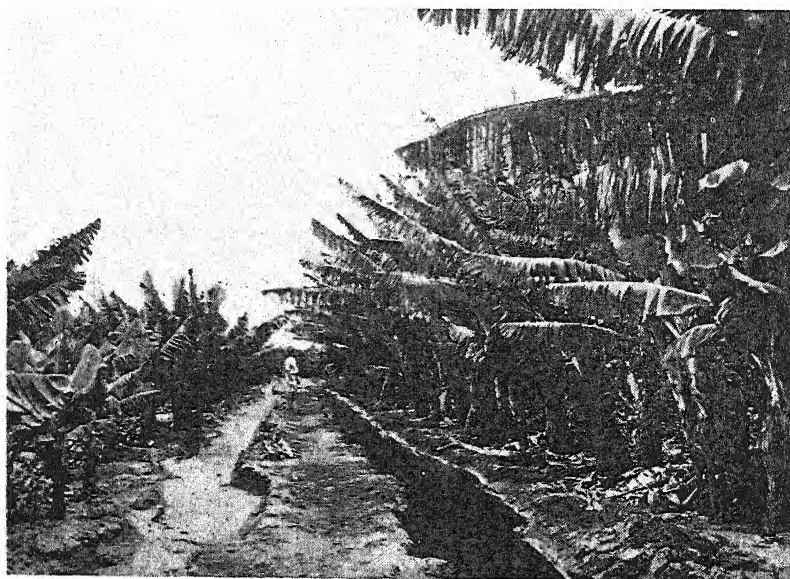


Fig. 14—Flooding system of irrigating banana plantation, five months old plants. Note how irrigation row has been widened. See Fig. 9.



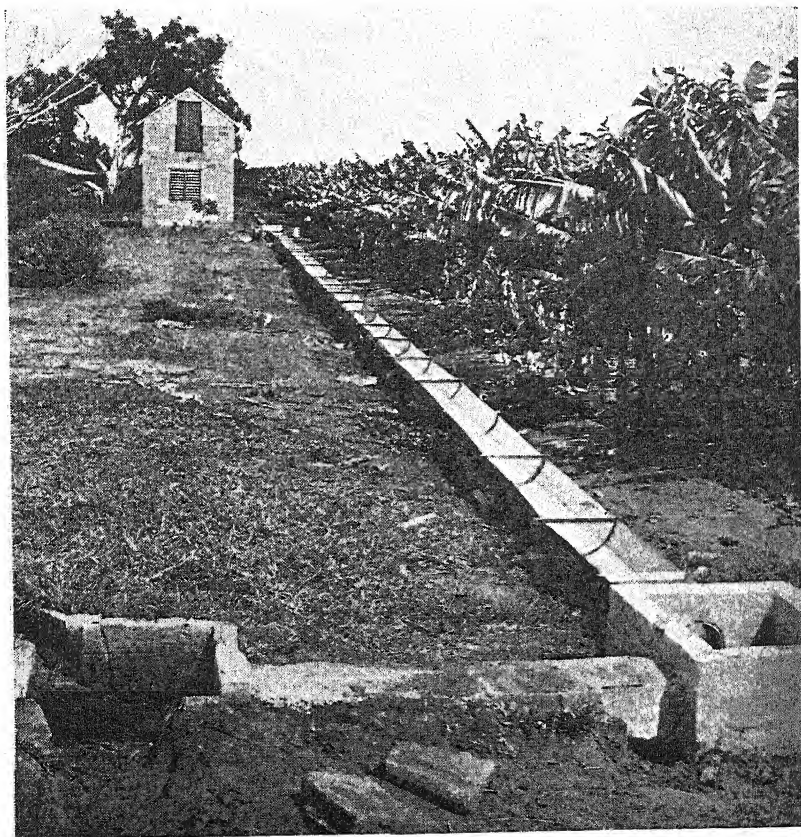
Furrow and hole method of planting and irrigating suitable for long rows.



Extravagant irrigation drain. This should be a quarter of the width and cemented
See also Fig 7B.



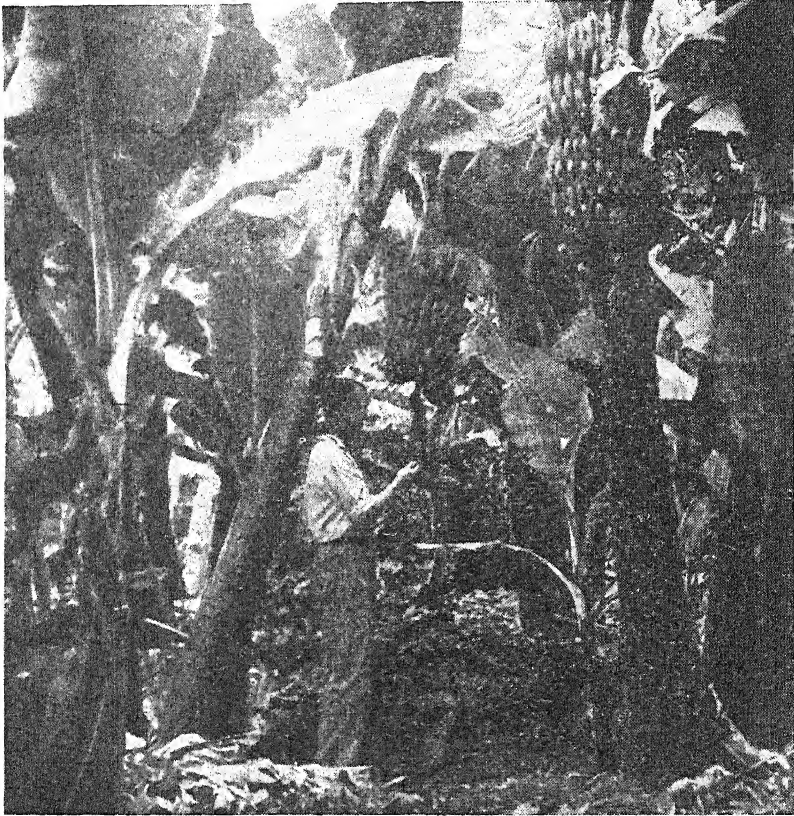
Flooding method of planting and irrigating. Not recommended for most Gascoyne soils.



A galvanised iron troughing type of irrigation drain that is in good order after 10 years' service. This type of irrigation line is portable from one site to another.

Removal of Tassel or Flower Ball.

Opinions vary as to the advisability of removing this from the plant. Some authorities do not favour the removal owing to the bleeding that occurs, but under trials carried out at the Research Station, there are indications that the lower hand develops better and that the bunch has a tendency to mature earlier when the tassel has been removed. The most favourable time to remove the tassel is after the third set of "neuter" flowers have died and the tassel stalk will snap off when bent at right angles to the bunch.



A scene in a William Hybrid (Golden Gros) plantation.

Trashing.

The grower should make it a practice of periodically going through the plantation and cutting off the dead leaves. There should be two main trashings, in the autumn and early spring, or just after manuring. On no account should the dead leaves be removed from the plantation. The leaves although highly loaded with water, contain valuable plant food and should where possible, be turned into the soil or left on the surface to act as a mulch.

The advantage of trashing is that, particularly in the winter, sunlight is allowed to penetrate the barrel and create warmth to the growing plant, as well as expediting the early development of suckers for early spring planting, which is so desirable under Gascoyne conditions.

Manuring.

It has already been mentioned that Gascoyne soils are low in organic matter so it is highly desirable to maintain green crops in the young plantation as long as possible. (Figs. 15A, 15B, 15C.)

After the first year of banana growth it is not found practicable to grow a satisfactory green crop owing to the canopy of banana foliage and therefore artificial means of supplying plant food are resorted to.

It is possible that it is during the early stages of the banana plant's life—first six to eight months—that the most care and attention to availability of plant food and moisture is essential and will largely determine the type of bunch eventually to be harvested. Some authorities claim that fertilizers have little or no effect upon the bunch if applied after the plant is eight months old. Experiments at the Gascoyne Research station support this opinion as the bunch is joined in the corm during the first eight months of the plant's life and after this stage irrigations appear to only assist to fill out the fruit and do not increase the number of hands or number of fruit on the hands.



Fig. 15A.—Cover crop of cowpeas in young bananas.

Under normal conditions ample supplies of organic manure are obtainable direct from the Wyndham meatworks and highly satisfactory results have been obtained by growers after applying blood and bone at the rate of 5 or 6 lbs. per plant per annum—in the early spring and again in late summer. These manurial applications are often supplemented by light dressings of sulphate of ammonia of 2 to 3 ozs. per plant per month. Applications should be made within a radius of two or three feet of the plant. Rather comprehensive manurial trials were initiated at the Research Station but these, unfortunately, were abandoned owing to war conditions before conclusive results were obtained. These trials embraced organic and mineral fertilisers, method of application, placement and frequency and will again be put under way as quickly as possible. During the shortage of manures over the past few years it has been found advisable to make one good application of manure in preference to a series of small applications. This applies particularly to organic applications such as blood and bone.

Keep in mind that excessive applications of nitrogenous manures, while producing prolific vegetative growth, can be harmful to the banana in that the carrying, keeping, and flavour qualities can be impaired.

For the present the new grower is advised to adopt the general manurial habits of successful growers.

Pests and Diseases.

Although the banana plant is subject to many serious diseases in other banana producing countries, the Gascoyne district is fortunately free of any of the major pests and diseases. A very rigid quarantine is kept of any plant material entering the State. However, should growers at any time suspect trouble within their plantation it should be immediately communicated to the Department for investigation in preference to any attempt at concealment.

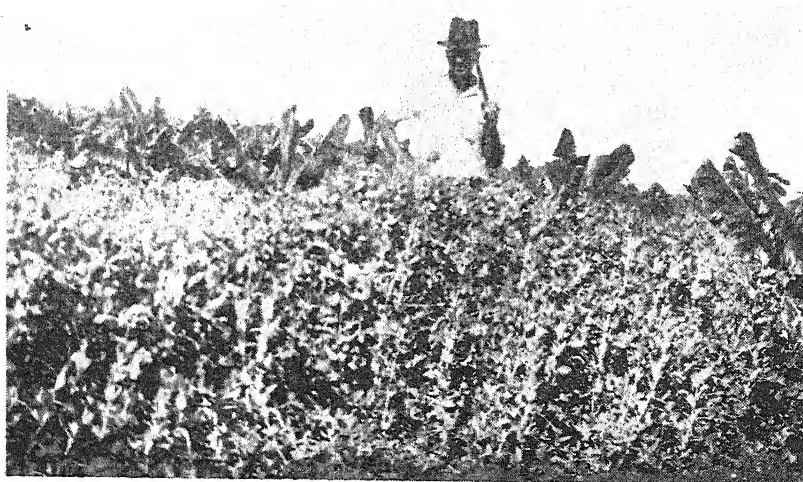


Fig. 15B.—Clover crop of field peas amongst young bananas.

Cultivation.

Providing thorough methods have been adopted in the preparation of the land prior to planting there is little need for intense cultivation during the life of the plantation. During the first year if green crops have been grown it is safe to use the plough, or similar tool, at a shallow depth but on no account should these implements come within a radius of several feet of the plant.

Normally the manure is turned in with a hoe and this should be used with considerable caution in close proximity to the plants.

Weed Control by Spraying.

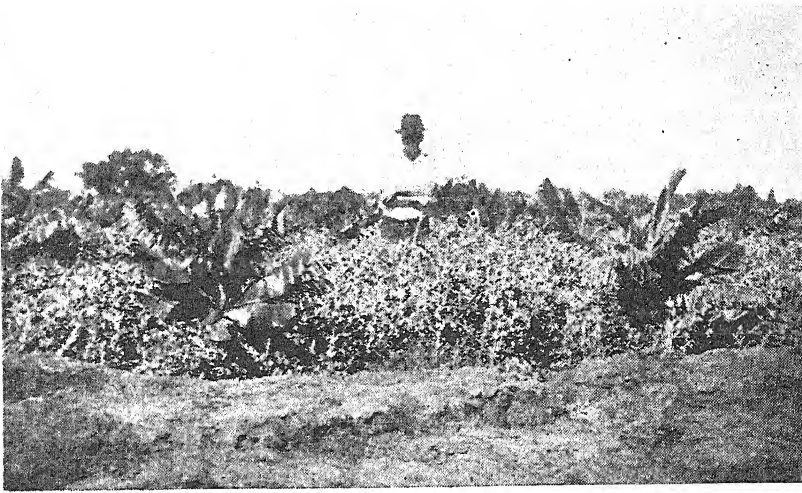
During the early life of the plantation, opportunity to combat weeds by cultivating is often not possible with the result that the weeds are allowed to seed making this future control more difficult.

As most settlers possess a knapsack or other small portable spray outfit, early and speedy weed control is possible by the applying of a weedicide to the troublesome area. While there are several proprietary lines on the market, the following formula will give satisfactory results, especially on the more succulent type of weeds, if applied in the early stage of their growth. Use 1 lb. of arsenic, 1 lb. washing soda, or $\frac{1}{2}$ lb. caustic soda and 12 gallons of water. To act as a spreader to this solution should be added soap or phenyle at the rate of 1 oz. to the gallon of spray.

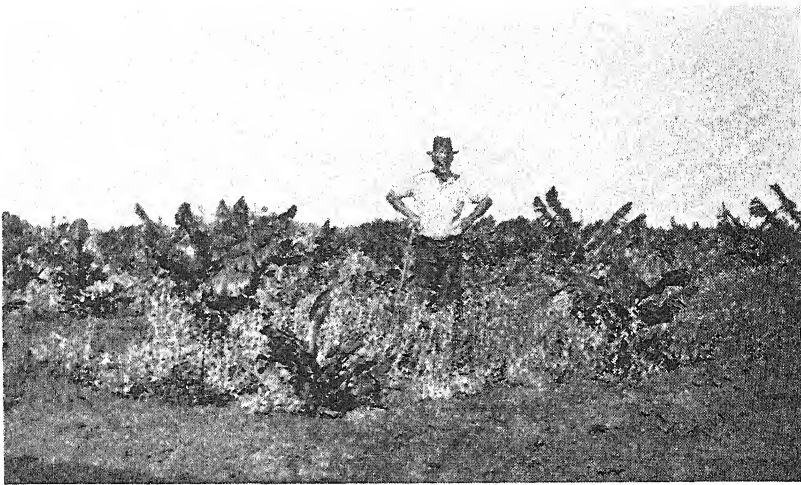
This spray may be applied as frequently as necessary without any apparent effect upon the soil for banana growing. As the spray is a poison, every human care should be taken.



Fig. 15C.—A clover crop of rice beans amongst young banana plants.



Cover crop of field peas with light dressing of sheep manure.



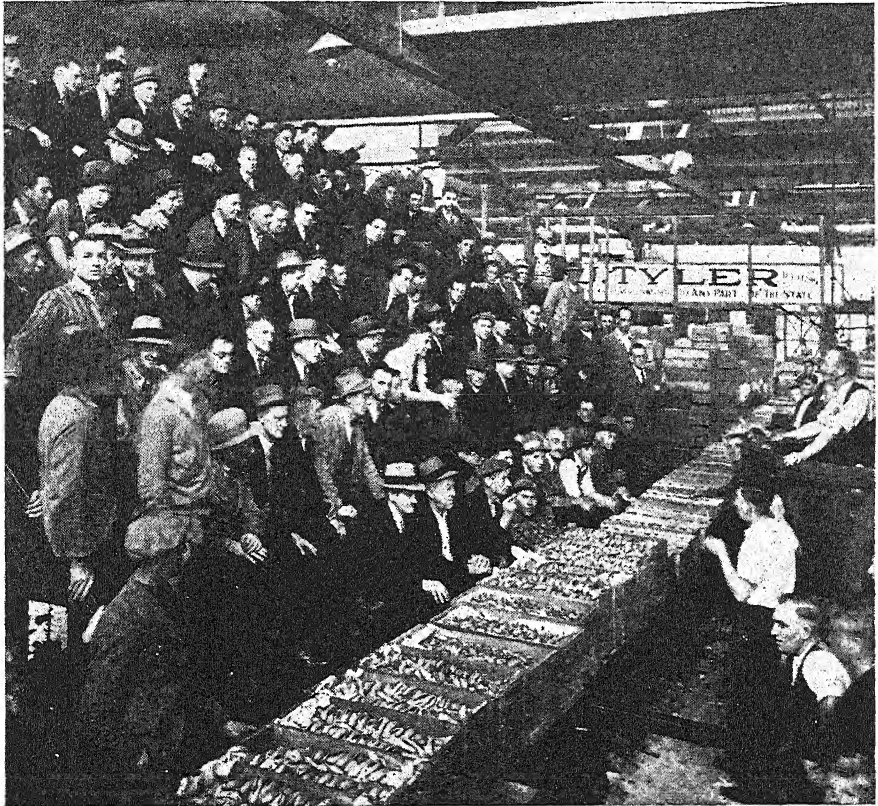
Cover crop of field peas without dressing of sheep manure.

Handling the Fruit.

With increased production in sight from the Gascoyne Settlement and the possibilities of greater competition from outside sources, it is highly desirable that all growers adopt the best possible methods of handling their fruit in the field, at the packing shed, and in the final presentation, the shop windows, via Metropolitan Markets.

If the Carnarvon product is to retain and extend its good name throughout the State inferior quality lines must be kept from passing "over the rollers." At the same time inferior fruit presented to markets may not only prove a loss to the grower but its presence tends to depress prices for better quality fruit.

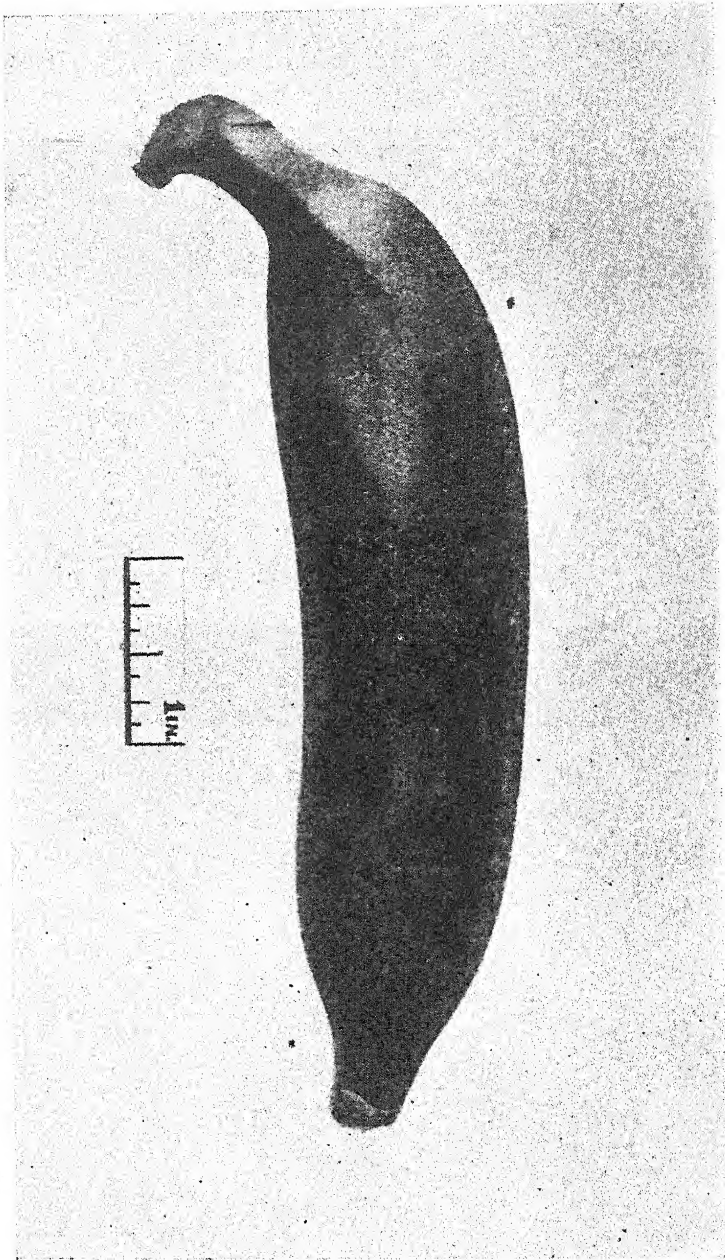
The buyers on the markets are experienced and keen business men and the grower who puts up the good pack of good size fruit is sometimes a poor attraction to them, simply because the grower has failed in his attention to one or more of the links in the chain of "preparation for market." The grower's watch words in preparation for market might well be "Carefulness, Cleanliness, Coolness," remembering that no grower can deceive the retailer who handles every banana before presenting them to his customers, also that the final judge of your fruit is, in the majority of cases, a thrifty housewife and it is her, through your agent, wholesaler and retailer, that you must satisfy if you wish repeat orders for your fruit.



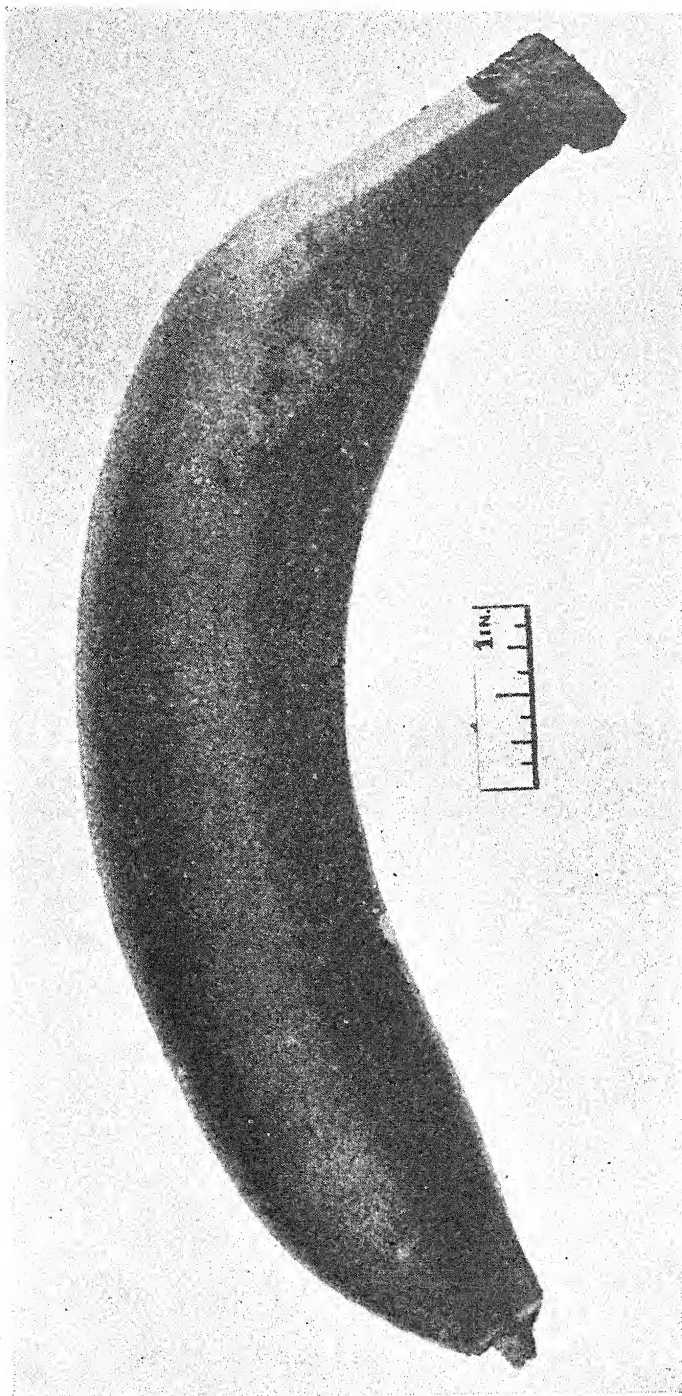
Bananas passing "Over the Rollers." A scene on the Metropolitan auction floor.
Note serious shrinkage of fruit pack in cases in foreground.

Varieties.

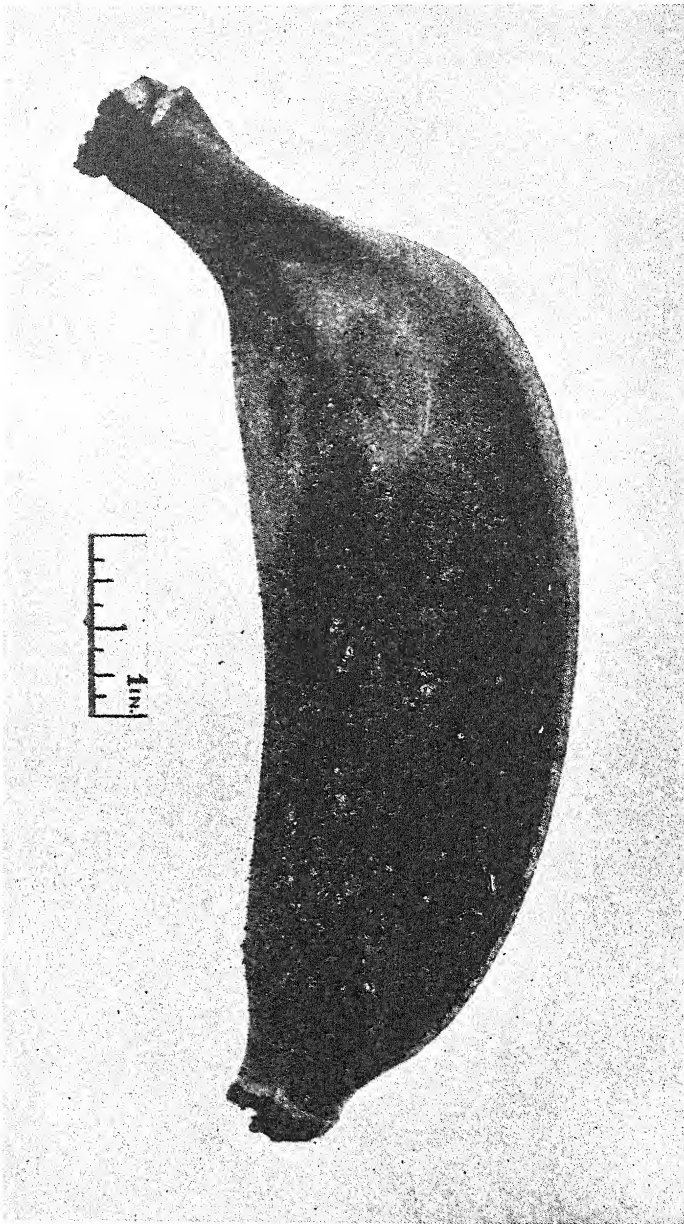
While there are at least a dozen types or varieties growing in the Gascogne, there are only two grown commercially, those being the Cavendish and Golden Gros or Williams Hybrid which is a mutant of the Cavendish. Other mutants of the Cavendish growing at the Research Station are Mons Marie, Veimama, Samoan China, and are growing quite successfully along with the Lady Finger, Sugar, Gross Michel. Several local Cavendish mutants are being tested out at the station.



The Sugar Banana.



The Cavendish Banana.



The "Lady Finger" Banana.

Harvesting the Bunch.

It is somewhat difficult to state the period at which the bunch should be cut. To say that a bunch is ready to cut when the fruit looks mature and well filled is not sufficient. This is a matter requiring a considerable amount of judgment, especially after abnormal weather conditions. Cutting time depends upon the season and condition of the plantation. In summer-time fruit should be

cut several weeks earlier than during the winter months. The hanging and keeping qualities varies with varieties. For instance, the locally known Golden Gros (Williams Hybrid) variety will hang longer than the Cavendish, but very full fruit of the former variety does not have the keeping quality, when ripe, as that of the Cavendish so that it is advisable (during summer months) to cut Golden Gros bunches a little earlier than in the case of Cavendish.

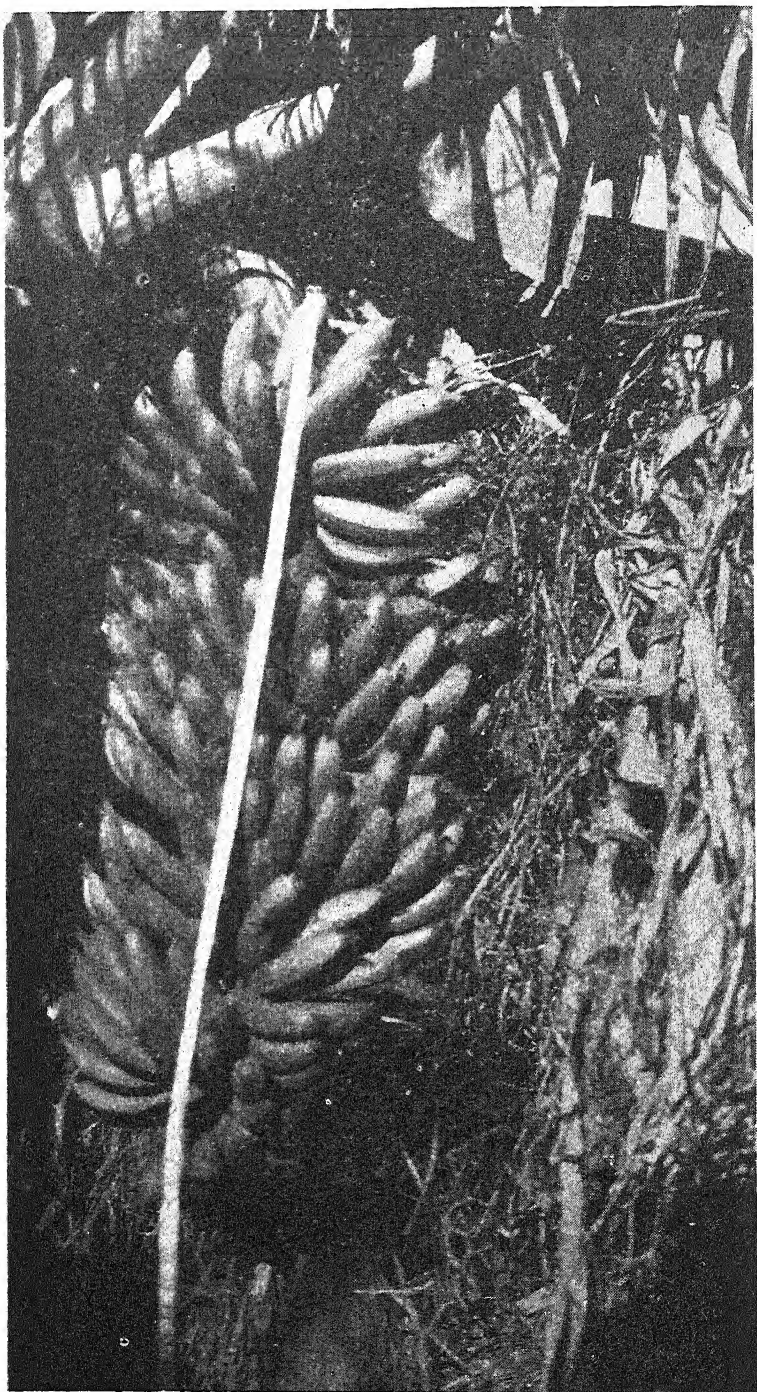
Harvesting operations should be carried out during the cool of the day. In summer time this is very advisable when the cutting should be done as early in the morning as possible. Avoid cutting late in the afternoon or evening in summer, while the fruit is warm, as such fruit is liable to possess poor keeping qualities.

When cutting the bunch, considerable damage may occur to the fruit if care is not taken by the harvester. It is advantageous to have an assistant when cutting heavy or tall growing variety bunches, so that one man can grasp the bunch by the stalk while the other severs the bunch. If this is not possible, the weight of the bunch must be borne by the operator by allowing the bunch to lie against the body while the stalk is cut. Avoid letting the bunch drop or rest on the bare ground for the lower hands will be blemished. The bunch, if not removed immediately to the packing shed, should never be laid down for fear of injury to the fingers at the stem ends, but should be stood upright on clean banana leaves or trash where the fruit will not be exposed to sun or wind. Where and when ever possible, bunches should be stood in an inverted position (that is, in a reversed position to which it hangs on the plant).

By adopting this method the lower hands will not be blemished as is so often the case. Never carry the bunch on the shoulder, as much fruit can be bruised in this way. If the fruit is to be carried by hand to the packing shed the job can be accomplished more comfortably if a yoke is used (Fig. 16). Every-time a bunch is handled some damage is likely to occur to the fruit and what may appear to the harvester as only slight harm to green fruit may reveal itself as

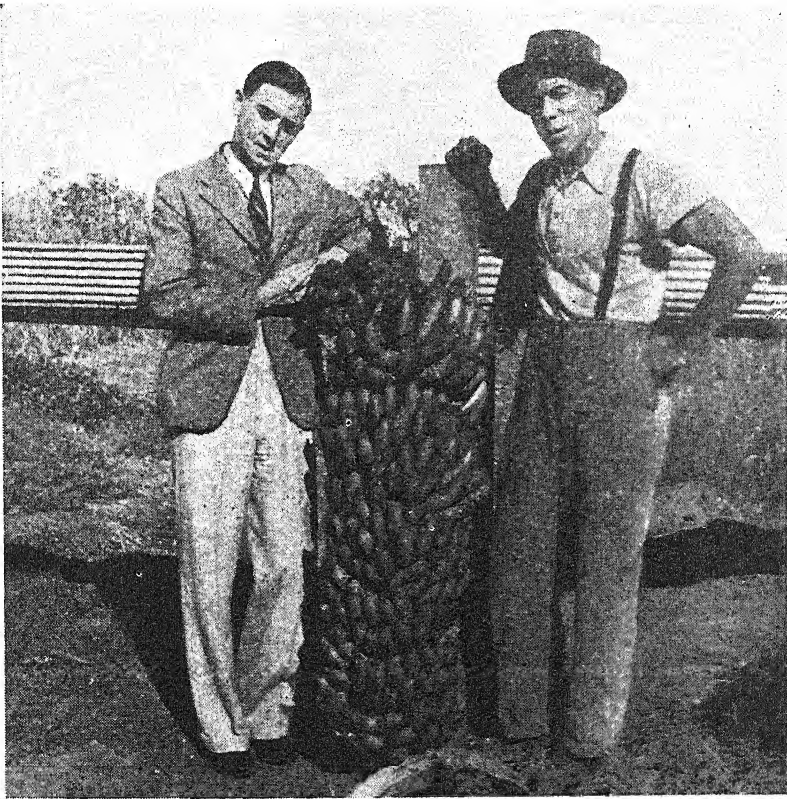


Young bunch, Cavendish variety.



A mature Cavendish bunch ready for cutting. Note the full round appearance of the fruit.

a major fault when ripened. It should be the grower's aim to handle the bunches as seldom as possible between cutting and nailing down. Seldom is it realised that the fruit is disturbed on an average of 12 times from the cutting of the bunch to being packed in the case. The method of handing fruit by one Gascoyne settler is worthy of recording. This grower, upon cutting the bunch, pierces an "S" shaped No. 4 gauge wire hook through the stem of the bunch and if the fruit is being conveyed by manpower to the packing shed a yoke is used and instead of having ropes attached to the ends of the yoke there are suspended wires with iron rings. The "S" hook in the bunch is then hooked into the ring on the yoke and conveyed to the packing shed. Upon arrival at the packing shed the bunch is suspended from overhead bars and is immediately hosed down with water. (Fig. 17.) (This latter action is not new to the banana world but has added benefits to Carnarvon bananas owing to the dust and high arid climate conditions. The washing of bunches is therefore highly recommended, for this action removes dust, prevents sap stain after dehanding, tends to keep fruit and shed cool and gives the fruit a decidedly brighter appearance when ripe.) Consideration should be given to the removing of the dried flowerettes from the fruit just prior to washing down of the bunch.



A bunch of William Hybrid (Golden Gros). This bunch weighed 110 lbs., length 4ft. 2in., girth 65in., marketable fruit 363.



Fig. 16.—Carrying bunches to shed on a yoke.



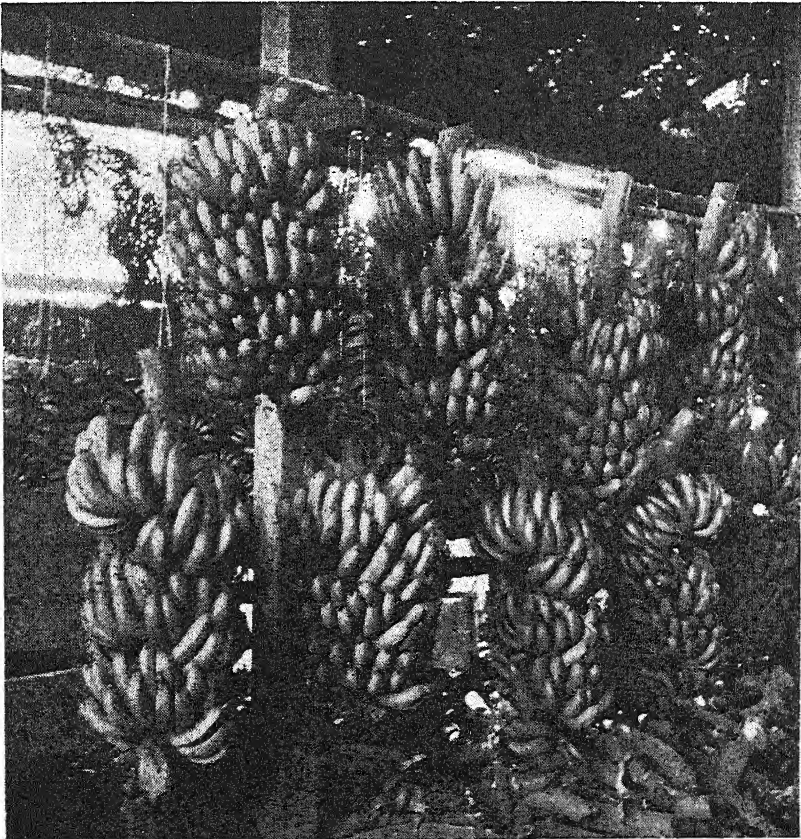
Fig. 17.—Bunches on rack dry off after being hosed down just prior to dehanding.

Dehanding.

When cutting the hands from the bunch a supple, narrow-bladed and pointed sharp knife will be found most useful. (Fig. 18.) A smooth semi-circular cut should be made so that a portion (about $\frac{1}{4}$ inch) of the cushion or flange is retained by the hand. (Fig. 19.) Too often is this operation carelessly performed and it should be recognized that it is very necessary that when the hands are broken into fingers that each fruit should possess a small portion of the flange

or corky wood at the stem-end. This prevents the fruit from shrivelling, gives the stem-end a full and well shaped appearance when ripened and will assist greatly in protecting the fruit from black-end, stem-end rot and other fungi troubles which are responsible for considerable wastage in what would otherwise be prime fruit. Harm can also occur through cutting the hand and leaving too much of the flange attached in that when breaking off the fingers at packing time the stem-end of the fruit may be strained, bruised or the skin torn.

Debanding incorrectly may defeat all the care and attention that a grower might otherwise give to his fruit and pack. Stem-end defects whether black-end, shrivelling, torn skins, etc., detracts from the fruit's appearance in the ripened case and shop window. Remember all cases are opened from the side for inspection and stem-end defects will immediately be seen by the buyer. To the consumer the fruit may look faulty, stale or unsafe and the retailer fully alive to the sentiments of his customers will either pass the fruit by or offer a low value to the wholesaler or agent. The cost of a sheet of sponge rubber matting, on which is placed the bunch at debanding, is well worthwhile. Some growers use a folded piece of sacking but even then the fruit on the bottom hand are blemished.



Bunches hanging in the packing shed awaiting debanding.

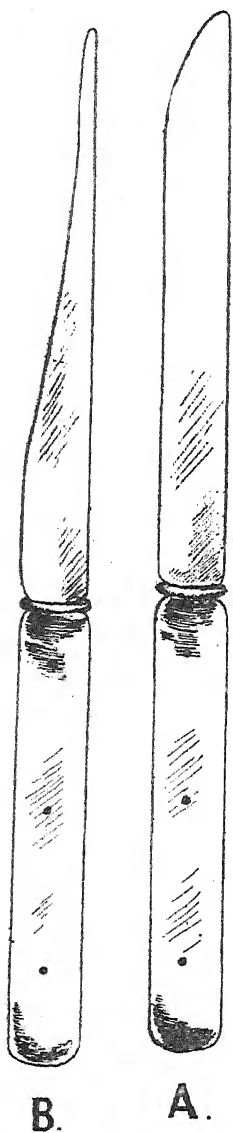


Fig. 18.—“B” a good type of cutting knife compared with an ordinary rounded end type “A.”

Refrain from straining the individual fingers when dehanding well curved fruit. With difficult placed hands it is better to make two cuts—one to remove the hand and the other to trim down the flange to the desired length of $\frac{1}{4}$ inch. Do not let the hands fall on the floor. (If labour is available dehanding can be carried out more speedily and efficiently by two men—Fig. 20—one man dehanding and the other taking away and stacking.) Do not throw or drop the hands on the bench, but stack carefully on the bench in concave (downward) fashion and in such manner so that as little as possible of the sap from the cut flanges drain on to the hands lower in the stack. (Fig. 21, A and B.) To facilitate packing movements the fruit should be carefully stacked in different grade heaps at time of dehanding. The practice of breaking up the hands at dehanding time and stacking the single bananas in grade heaps is not only adding to labour and time but causes extra handling and blemishing of the fruit.

The fruit, after dehanding, should be allowed to sweat for 12 to 24 hours prior to packing in winter, but this period can be greatly reduced during summer. Effective sweating cannot be obtained by allowing the hands to remain on the bunch, so de-hand one day before packing. During summer months, and even during easterly wind days of winter, the covering of the dehanding fruit with damp sacks or some other coarse material is advised. Endeavour to avoid packing fruit while wet and hot. Too much emphasis cannot be stressed upon the necessity for *all* growers to strive to keep their fruit cool at all times, especially during packing shed operations. Repeatedly has the Carnarvon product gained great popularity in the metropolitan area only to lose considerable ground during the summer months, the common complaint from retailer and consumer alike being that our fruit lacks colour and does not keep. This complaint is gradually being overcome with the greater realisation, by growers and carriers of the necessity for keeping the fruit cool. Keep in mind that the

ideal temperature for long life in the banana is 50-60 degrees. This cannot be achieved by the grower but he can do a great deal towards that point. A packer can often be deceived during the summer months by rising temperatures and an investment of a few shillings in a wet and dry bulb thermometer or unsheathed thermometer will prove of value and great interest in the packing shed.

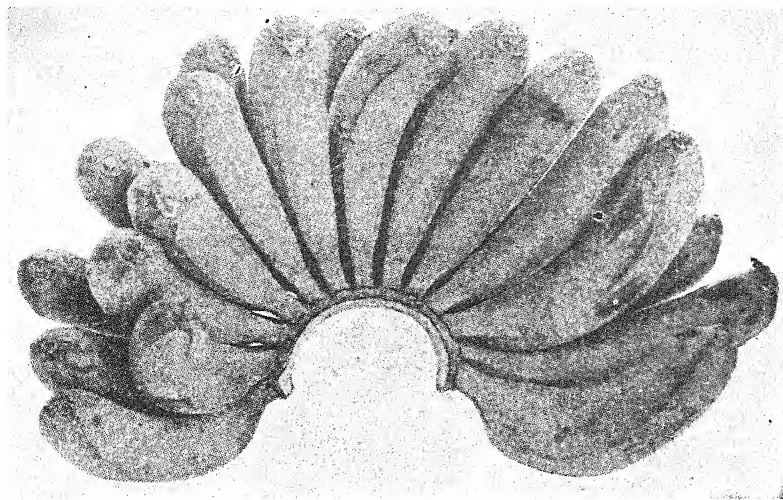
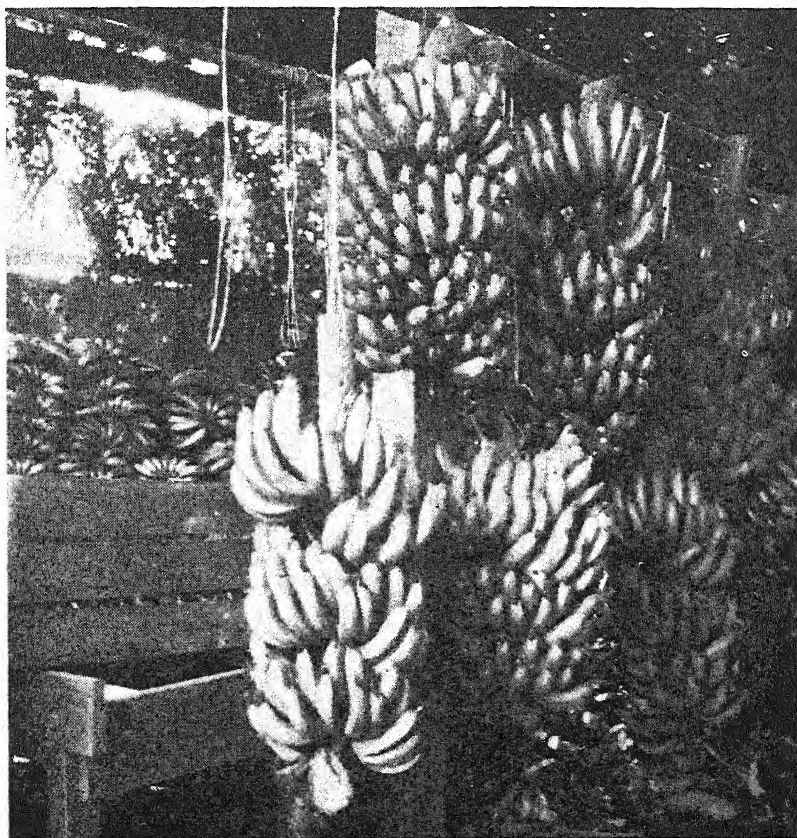


Fig. 19.—A correctly dehanded hand of fruit.



Another view of hanging bunches awaiting dehanding. Note hands on bench in background.



Fig. 20.—Dehanding. Note bunch sitting on rubber pad.

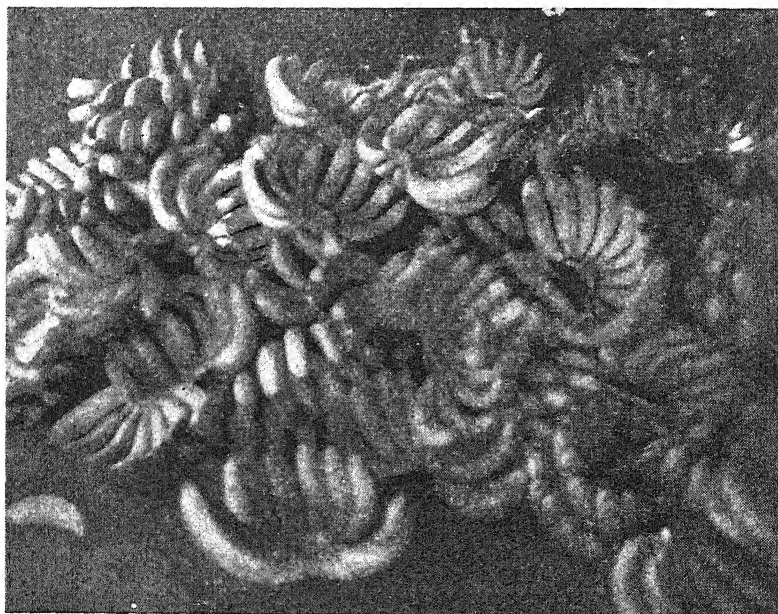


Fig. 21A.—Scene in packing shed. The way NOT to stack hands.

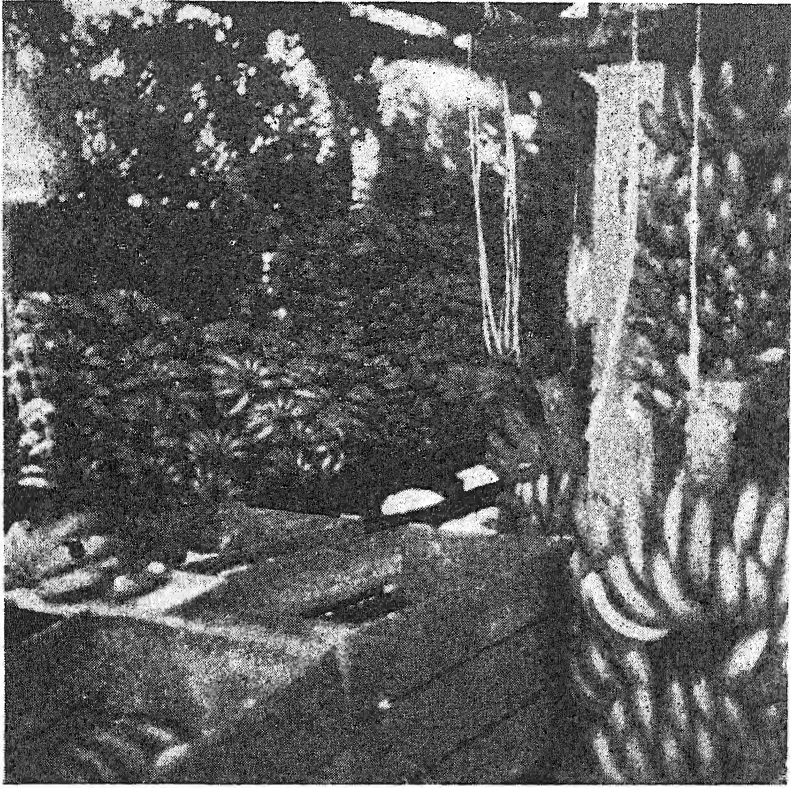
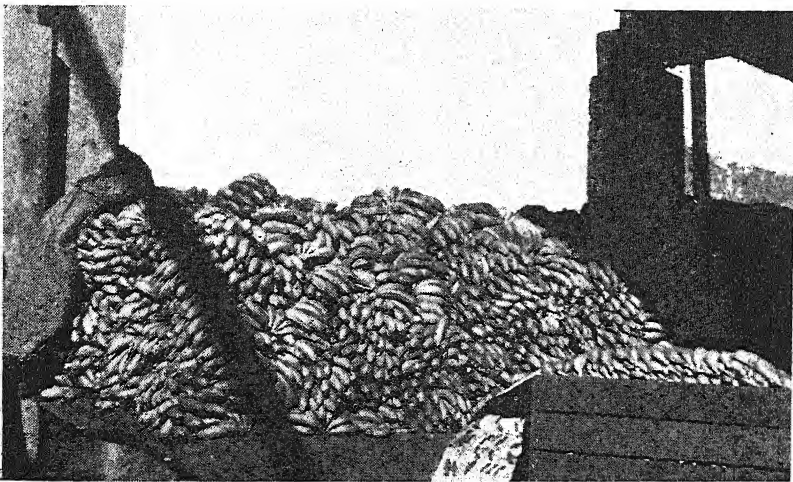
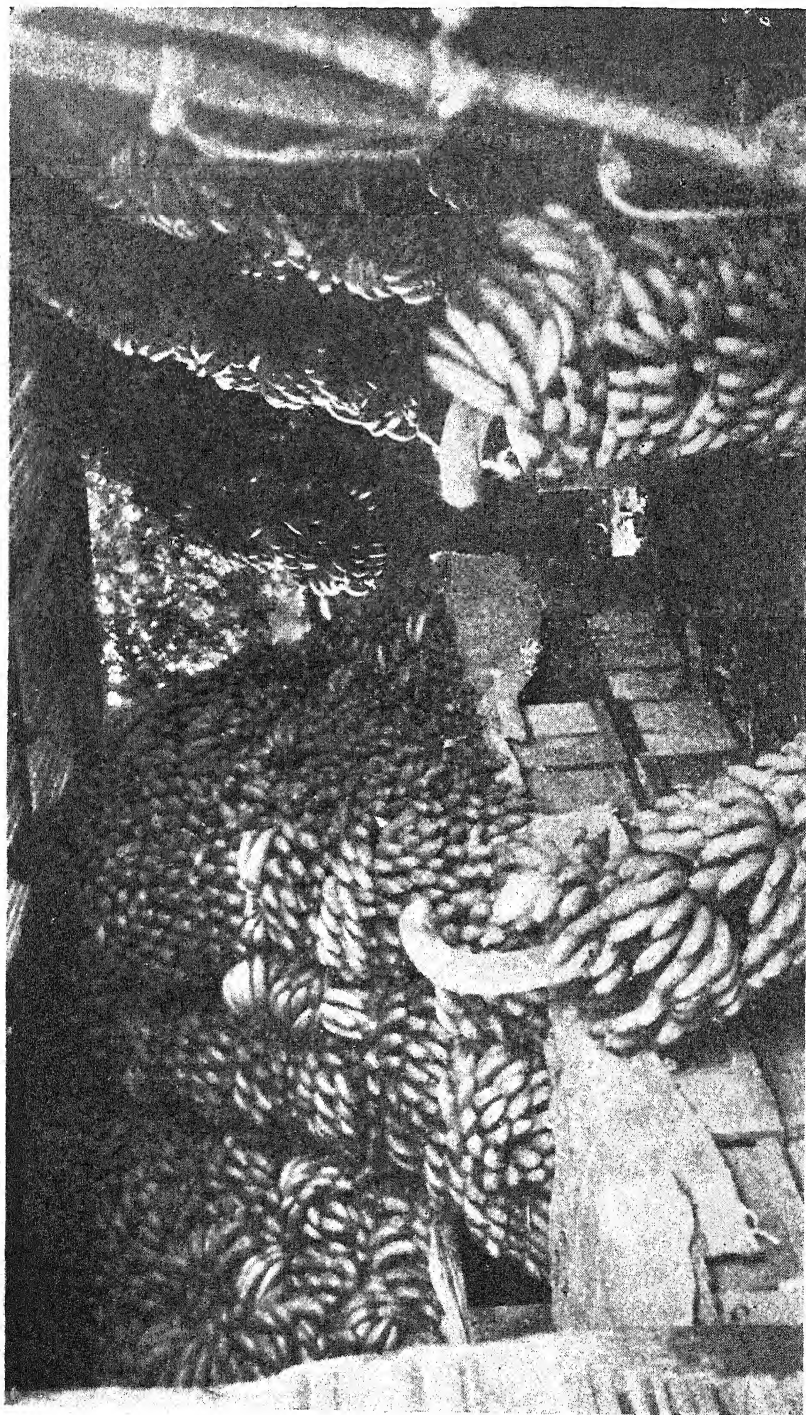


Fig. 21B.
Correct way of stacking hands.



Fruit carelessly stacked on bench and exposed to sun. This treatment is bound to give short life and impair the quality of the fruit when ripened.



Scene in packing shed. Fruit stacked ready for packing. High stacking such as this not advisable owing to the possibility of excessive weight damaging fruit at bottom of stack.

Packing Shed.

As the packing shed is the last place where the grower has personal control over his product, comment would not be out of place concerning the growers "dressing room" of his labours. It must be admitted that many packing sheds are crude and inconvenient structures, especially for the handling of such a delicate fruit under the extreme summer conditions that are at times experienced on the Gascoyne. Official records have revealed that more fruit is heat affected in the packing shed than at any other point in the handling of the fruit.

It is not suggested that an expensive or elaborate building should be erected as a packing shed, in fact this is not necessary. The building should be in as centralised a position as possible, so as to facilitate the handling of the fruit from the plant to the packing bench. The building should be well ventilated and the floor should be cemented, with a gradual slope to permit copious watering and draining and made spacious enough to avoid cramping of packing movements. Earth floors are not only objectionable on account of being dusty or muddy but there is ample evidence to indicate that the few bags of cement required for the work of cementing the floor will eventually repay the grower with the increase in price gained for cleaner and healthier appearance of his fruit

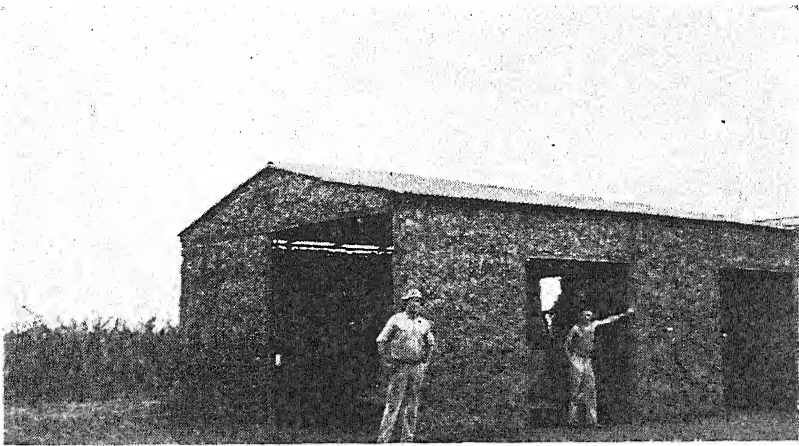


Fig. 22.—Packing house made of banana leaves or trash.

The advantages of abundance of light and ventilation are obvious and every extra foot in height given to the roof will be of benefit.

If the roof or sides on a building are of iron it should be covered with green creepers as speedily as possible. An economic shed can be made with hessian sides that may be rolled up or down. There are various types of local material available for the covering of packing sheds. The Nor' West or Worramel creeper makes a rapid and splendid covering but owing to its profuse flowering and fruiting habit it encourages rodents to make it their habitation and eventually they attack fruit stacked in the shed. An excellent cool and long lasting shed can be very economically constructed by erecting double walls of wire netting in between which is packed banana trash. (Figs. 22 and 26.) Another splendid cool and long life shed can be erected from palm leaves, reeds or Yantie grass. The walls of such buildings can be watered during summer and a considerable drop in temperature attained. The watering of the walls can be ideally carried out by the erection of a small overhead tank connected to a small pipe line placed

round the top of the sides of the building. Small holes are bored every 4-6 inches along the side of the piping. The piping should be erected with the holes facing downwards. An ordinary garden sprinkler running on the roof is an agent towards reducing high temperatures.

Packing Shed Layout.

The layout within the shed should be such that will secure the greatest saving in time and handling. The bunches should enter one end of the building and the entire handling be so arranged that the packed cases are delivered to the truck at the opposite end of the shed.

The habit of packing fruit from the floor is to be discouraged. The cost of benches is not very great and should reduce the amount of damaged and dirty fruit, at the same time giving considerable more floor space. All possible means should be adopted to prevent the fruit coming in contact with soil for it is quite possible that this can be responsible for disease and decay that develops after the packed cases are forwarded to ripening rooms or markets.

Benches should be approximately 30 inches high and the floor of such covered with bags or hessian that can be readily removed for hosing down and cleaning.

While these suggestions, if adopted, will go a long way towards economic and a better presentation of the product the efforts of the grower may be defeated if strict attention is not paid to cleanliness. Finance may restrain some growers from erecting spacious and otherwise suitable sheds but there can be no excuse for dirty and untidy conditions within any packing shed. The shed and benches should be swept out just prior to bringing in of the bunches and immediately after the packed cases leave the shed. All stems, waste fruit and other rubbish should be carted well away from the packing shed and shed precincts, and destroyed.

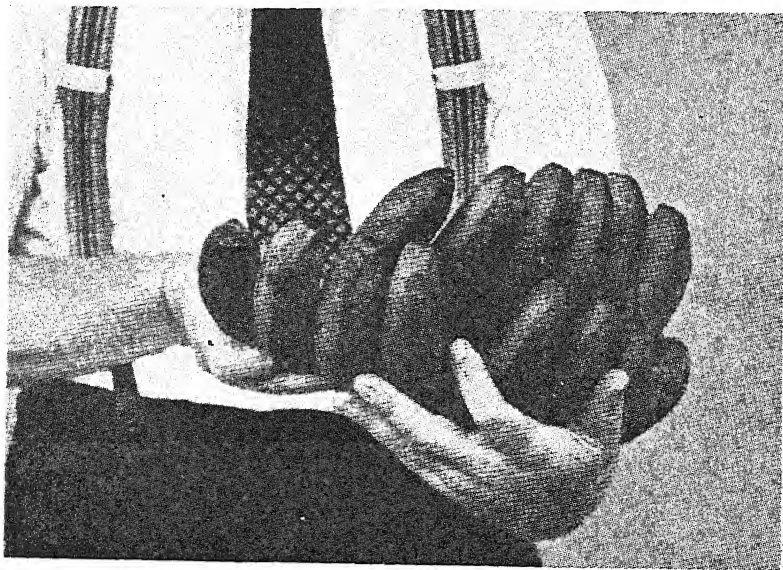


Fig. 23.—Method of holding the hand of banana for breaking. The weight of the fruit is supported by the arm, preventing any possibility of strain on the shanks of the fruit.

Breaking the Hands.

If the hands have been cut correctly from the bunch the breaking up of the hands into singles or clusters is a simple operation but there is a correct and incorrect method. The hand of fruit should be placed in convex fashion in the packer's outspread hand with the stem-end of the fruit facing towards and close to the wrist. (Figs. 23 and 24.)

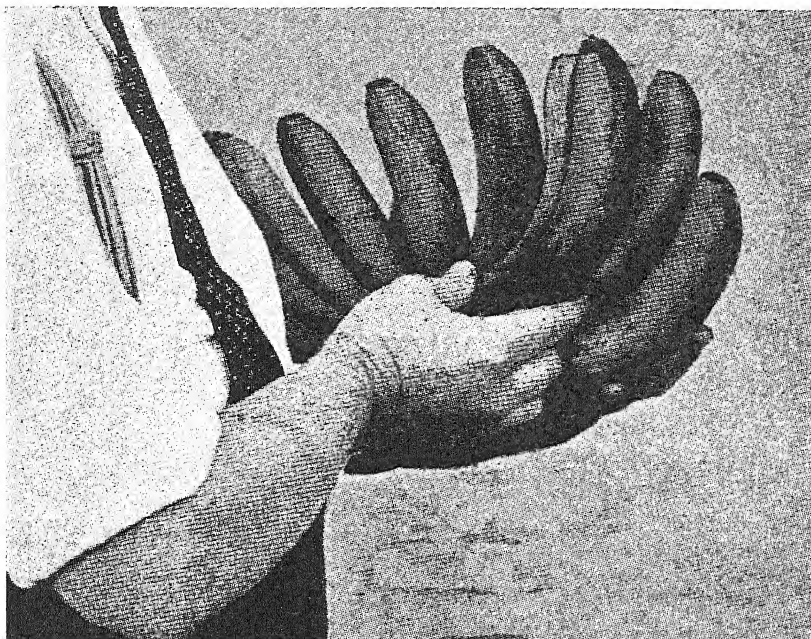


Fig. 24.—Breaking bananas from the hand. Note how the fruit is held by the shank.

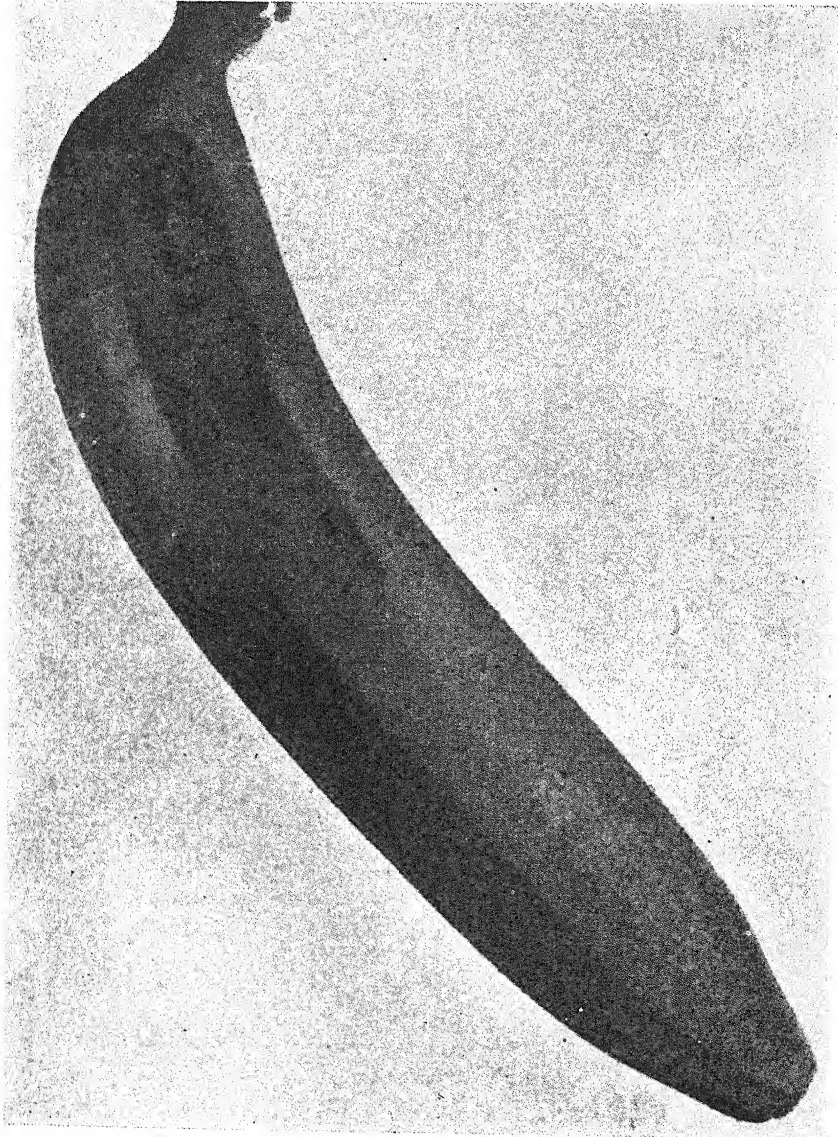
The individual fruit is then grasped firmly by the stem-end and with a semi-circular motion is broken off the hand.

Holding the hand by the calyx or flower end of the bananas or of holding the individual fruit at the flower end is not advisable for these actions may cause damage to the fruit at the stem-end. The harm is not apparent until the fruit reaches the ripening rooms or markets. Consideration might be given to cutting the hands into singles in lieu of breaking. Cutting certainly gives the banana a better appearance when ripened.

The case should be well constructed of clean neatly cut timber, with the even spacing of all boards and the straight driving of all nails. Use nails of suitable length, especially when making up ends when the nails should be slightly longer than the thickness of the cleat and case end to allow clinching of the ends of the nails on the inside of the case ends. Nails that protrude through the sides of the ends of the case should be either withdrawn or hammered down otherwise a grower is courting trouble during the handling stages of the packed case in the event of injury to the carrier who may, in false justice for injury occurred, drop the case in no uncertain fashion. While the standard tropical fruit case is used entirely in Western Australia, consideration should be given to the new case which has been adopted in the Eastern States and the $1\frac{1}{2}$ bushel case discarded. The new case is similar to the $1\frac{1}{2}$ bushel tropical case

except that it is four inches shorter in length. It is claimed for this case that there is less bruising of the fruit, less case breakage owing to elimination of much rough handling, and that sales are increased.

No one will deny that an unattractive container tends to mar the contents of any product and the banana case is no exception. Far too often is observed the careless and by no means neat stencilling. At times stencil markings are difficult to read and this will at times cause extra handling when sorting at Fremantle. It also appears that some growers' cases carry too great an amount of stencilling. There is need for the standardising of stencils amongst growers. The agent's name could be abolished and either a number or letter substituted. This would eliminate the conglomerate of stencilling that is to be seen at times.



The Gros Michel Banana.

Under the Fruit Cases Act growers are required to brand or stencil their cases with letters or figures not less than three eighths of an inch in length, setting out the name of the district, name of fruit and the quantity in bushels. In lieu of the name of the grower a brand may be used providing such brand has been approved and registered by the Department of Agriculture. A fee of seven shillings and sixpence is the cost of a registered brand. Place your stencils so that the lettering is parallel with the cleats on the end of the case. Stack shooks and made up cases in a sheltered and shaded place. Avoid packing into cases that have become hot through standing in the sun.

Grading.

At the present time there does not appear to be uniformity of grade sizes amongst growers and it is very desirable for the industry as a whole that an effort be achieved towards standardisation of the banana. At present growers are adopting the practice of banana districts in the Eastern States by stencilling their cases "sixes," "sevens," "eights," "nines," but while the individual grower may be consistent with his packed contents, there is a lack of uniformity amongst the growers collectively.

Standardisation of grades will go quite a long way towards the producers' desire for the stabilisation of markets.

While it is the writer's desire to see a co-operative effort for uniformity of grades it is not intended to dwell upon this desire in these notes, and, for the present, it should be the objective of each grower to determine a standard grading formula for his own use and to maintain it.

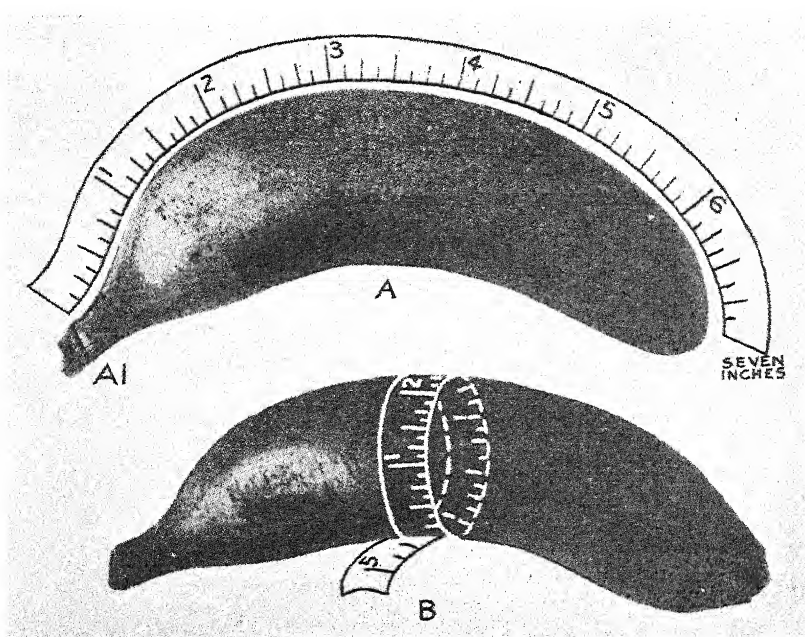


Fig. 25.—Method of measuring the length and girth of a banana: A. The length of the fruit is taken from the raised girdle (A1) to the centre of the end. B. The middle of the banana is where the measurement for the girth is taken.

The following grade standards are recommended:—

“Smalls”: Fruit not less than 5 inches but less than 6 inches with minimum girth of 4 inches.

“Sixes”: Fruit not less than 6 inches but less than $6\frac{1}{2}$ inches in length and 4 inches in circumference.

“Sevens”: Not less than $6\frac{1}{2}$ inches but less than $7\frac{1}{2}$ inches in length and 4 inches in circumference.

“Eights”: Not less than $7\frac{1}{2}$ inches but less than $8\frac{1}{2}$ inches in length and $4\frac{1}{2}$ inches in circumference.

“Nines”: Not less than $8\frac{1}{2}$ inches in length and $4\frac{3}{4}$ inches in circumference.

The length of a banana is measured on the outside of the curve from the junction of the fruit at the stem-end to the apex or calyx end of the fruit. (Fig. 25.)

At present, under Prices Regulations, selling by weight has been almost universally adopted by producer and retailer and whether at a later date the pre-war custom of selling by count will again operate is a matter of conjecture.

The present method certainly is not in the best interest of the consumer for the additional handling by weight tends to bruise the fruit and also adds to the labour of handling by both wholesaler and retailer.



Fig. 26.—Correct packing position. Note cement floor, stacking and packing benches, ventilation and ample light in building, all helping to complete a good pack.

Packing.

There are several methods of packing such as in hands, part hands, or clusters and singles. There is no doubt that the packing in the full hands is the ideal packing method but there are a few difficulties experienced if the fruit

and hands are not all of similar shape. The part hand or cluster pack is next in preference and apart from greater speed in packing, less damage, less black-end and stem-end trouble is likely to occur to the individual fruit than when breaking the full hands into singles. With the cluster pack it may be permissible to work two grades in the case.

Consideration might be given by growers to the use of the cluster in preference to the singles pack. This pack was adopted for a short time by one grower and met with only fair support from buyers but the objections then raised can be overcome with the present improved cultural methods and more even type fruit. One of the buyers' main objections to the cluster pack is that the case does not contain the "count" as that in the single pack. With a little experience in packing cluster fashion, the grower will pack practically the same count as with the single pack. He will also find that less time and labour are required. (This factor is also to the advantage of the retailer.) Clusters ripen with a brighter and fresher appearance especially at the stem-end than in the case of singles.

While the single pack is the present standard on the Gascoyne and most growers should be conversant with the various ways of packing singles, there is evidence that these operations cannot be too frequently described.

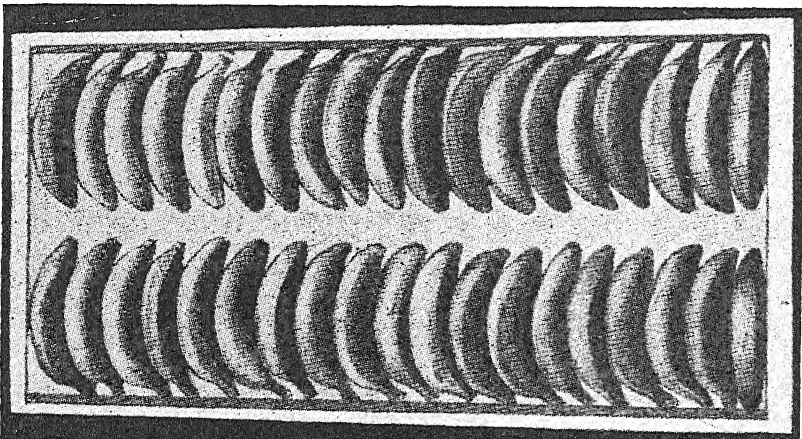


Fig. 27.—Method of packing first layer of "sixes" and "sevens." Note how last banana is turned downwards to give a tight lock to line of fruit.

The packer should stand at one end of the case and not at the side as is sometimes seen. (Fig. 23.) The end of the case furthest away from the packer should be slightly raised. All layers of fruit should be commenced at the end nearest the packer. With the packer at the end of the case and with the opposite end of the case slightly raised it will be found that the packer can pull the fruit gently into position, especially when placing the bottom layers in the case and thus assuring a firm foundation to the eventually packed case.

In commencing the pack with average "sixes," "sevens" or "eights," two rows of bananas are laid gently on their sides along the bottom of the case with the stem-end of the fruit touching the sides of the case. (Fig. 27.) The first layer must be packed firmly for if the foundation layer is loose the complete pack must be loose. Particular attention should be paid to the last fruit in the first rows, where the last fruit in the rows should be made to act as a lock on the fruit in the row. Fairly straight fruit can be used to advantage for this purpose.

Similar shaped fruit can be used to advantage in the centre between the two rows, and they should be packed firmly into position so that the stalks of the other fruit are pressed firmly against the sides of the case (Figs. 28 and 29). Remember that once the case is nailed down the case from thereafter is laid on its side and any slackness in the centre of the pack will permit the layers to move causing damage to the fruit. Various methods of packing the centre of the case are depicted.

The second layer of fruit is placed on top of the first rows in the spaces between the fruit. (Fig. 28.) This fruit can either be placed concave downwards or on their sides. Whichever method is used it should be uniform throughout the placing of this layer. With long stemmed fruit it is advantageous to place the second layer of fruit on their sides as this will avoid damage to the stems when the bulge is placed on the lidded case.

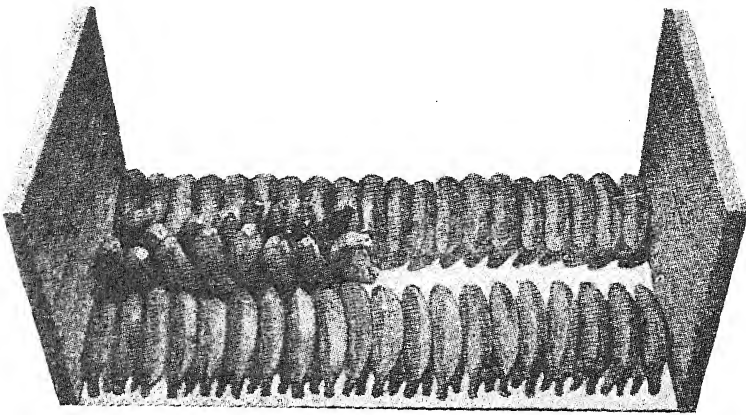


Fig. 28.—Method of placing second layer. Fruit should be placed as far as possible, in the spaces of the first layer, concave downwards. Note the vertical method of placing the centre fruit when pegging which may also be placed concave downwards.

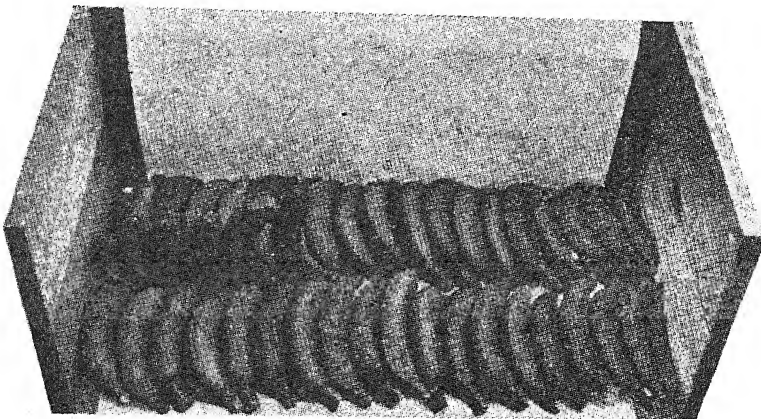


Fig. 29.—Showing placing of centre bananas.

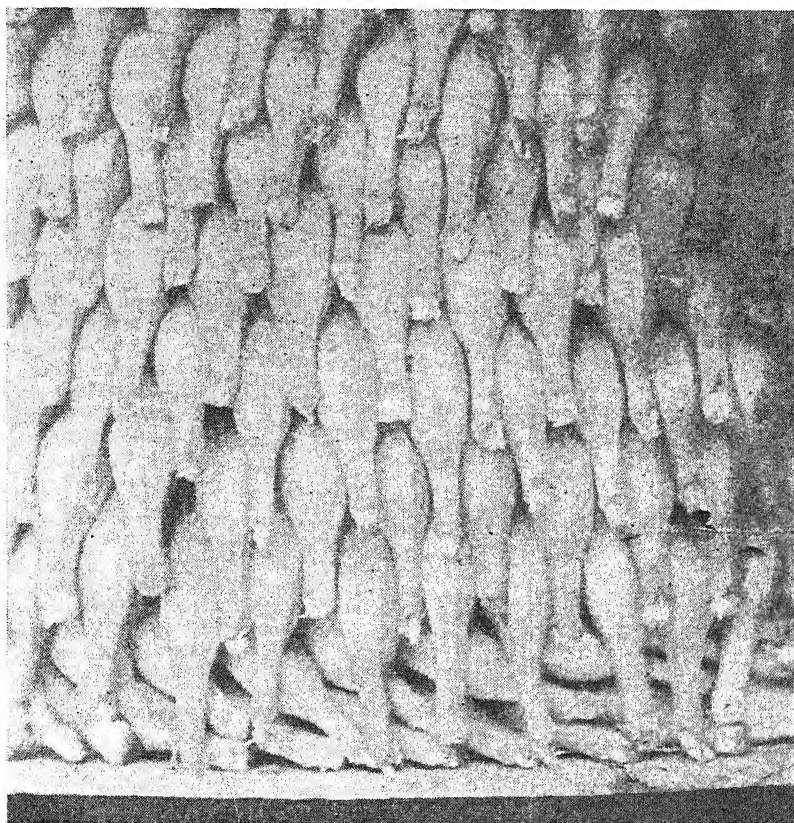


Fig. 30.—In each layer the fruit is placed in the spaces between the fruit of the previous layer.

The third and subsequent layers should be placed concave downwards in the spaces between the fruit of the previous layer (Fig. 30) making sure that the stem-ends of all fruit go well down on the sides of the case but not so that the shoulder of the fruit itself touches the case. As the case is being filled layer by layer make sure the centre is firmly filled with fruit of the same grade as the remainder of the case. **Do not use smaller fruit for the centre.** (Fig. 31.) The last two layers may be made up of nicely curved fruit that will give the pack a very attractive appearance and will also facilitate and avoid stem-end damage when nailing down the lid. (Fig. 32.) The last layer should come above the top of the case but just how high the pack should be will depend upon the quality of the fruit. This point is soon gained by experience and the correct bulge after the case is nailed down should be 1-1½ inches. Finished packs of sixes, sevens, eights. (Figs. 33, 34, 35.)

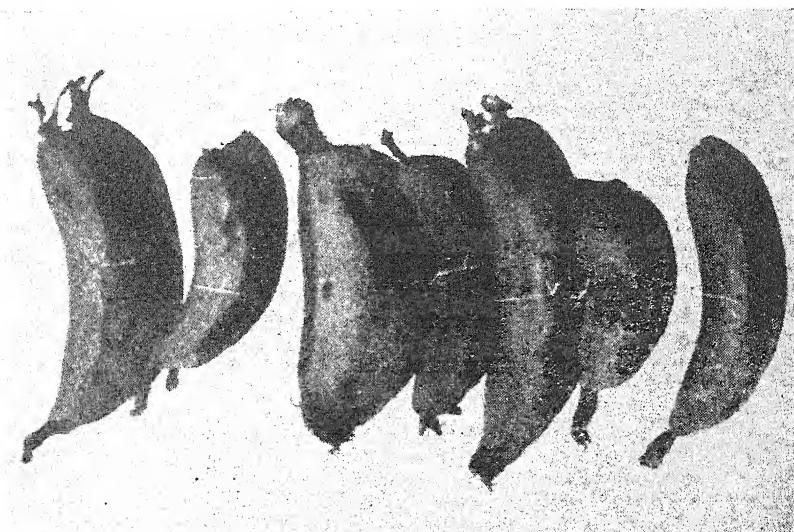


Fig. 31.—Fruit removed from centre of a case of "sevens" at Metropolitan Markets.
Note uneven grade of fruit and damaged stem and blossom ends.



Fig. 32.—Nicely curved fruit for top layers.

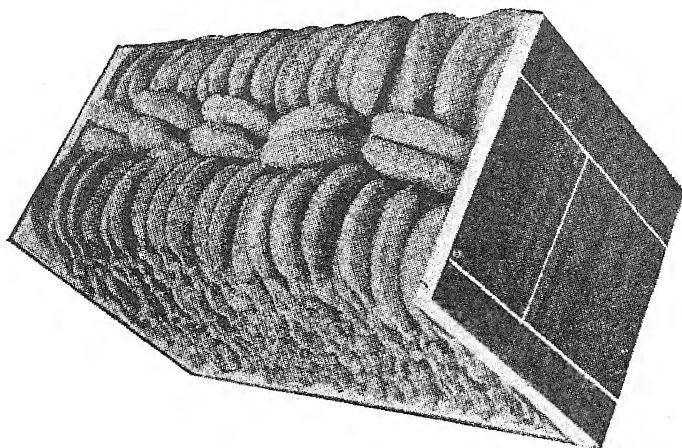


Fig. 33.—Finished case of "sixes."

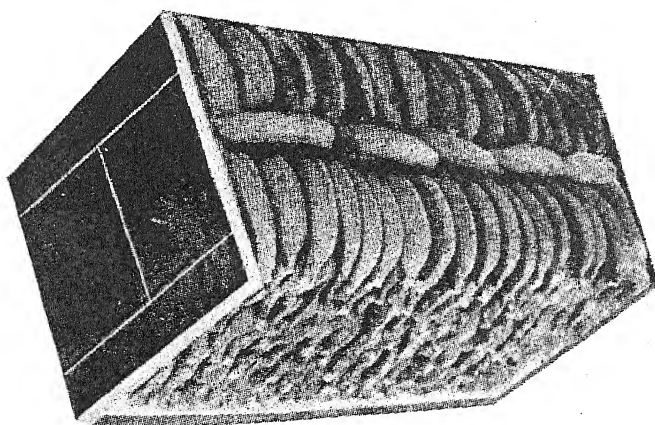


Fig. 34.—Finished case of "sevens."

Alternate or Flat Pack.

The bananas are placed singly on their sides as in the concave pack for "sixes" and "sevens." The fruit in the second layer is also placed on its side on top, but between the fruit of the first layer with the curve of the fruit reversed to that of the bottom layer. The third layer is also laid flat and the curve reversed to that of the second layer, and so on, until the case is filled. A very solid pack is thus obtained and as there is not so much "give" as in the concave pack there is not the necessity to secure so great a bulge on the lidded case.

In packing "eights" the fruit is placed in the case in a similar manner to that described for the concave "sixes" and "sevens" pack but no centre bananas will be required. (Fig. 35.)

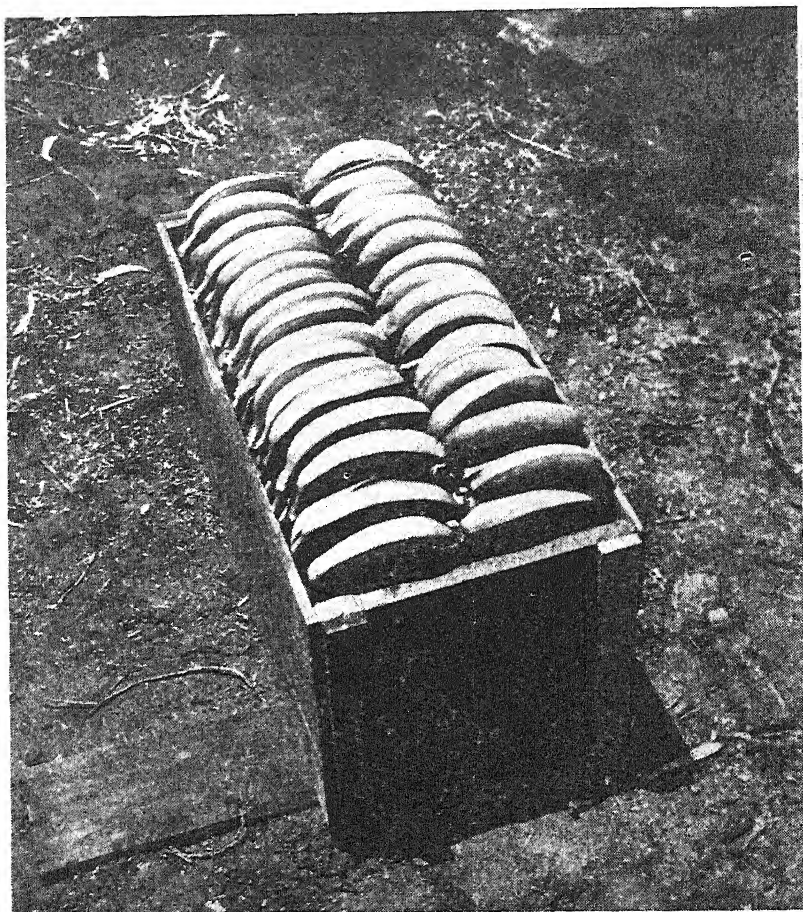


Fig. 35.—Case of "eights" packed.

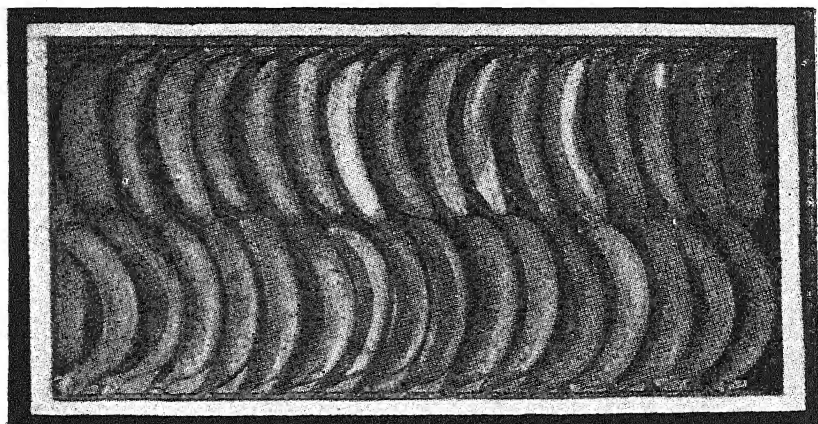


Fig. 36.—Method of placing first layer of large curved "eights."

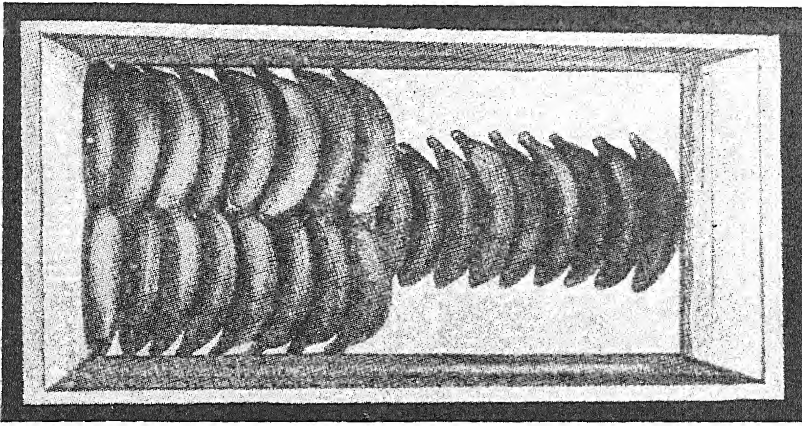


Fig. 37.—Another method of placing first layer of large “eights” and of “nines.”

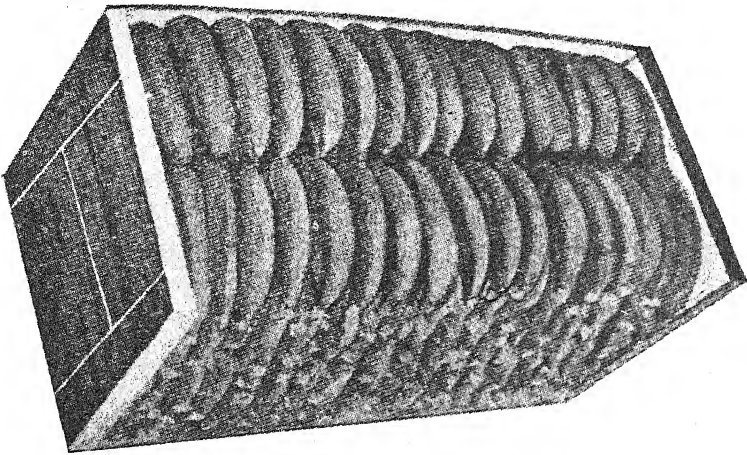


Fig. 38.—Completed case of “nines.”

With some lines of “eights,” especially with curved fruit, the “S” type pack (Fig. 36) will be found useful. In this pack one row of the bottom layer is placed reverse to the other giving the bottom layer an “S” appearance. The second layer is placed similarly between the first layers but all subsequent layers are placed concave downwards.

With large “eights” and “nines” a layer of fruit is placed down the centre of the case and then the next layer is placed on its side. (Fig. 37.) The layers from thereon are placed concave downwards as in the ordinary concave pack. (Fig. 38.)

To obtain a good solid and attractive pack it is necessary to complete each layer of fruit before commencing the next layer. (Fig. 39 depicts a perfect pack.)

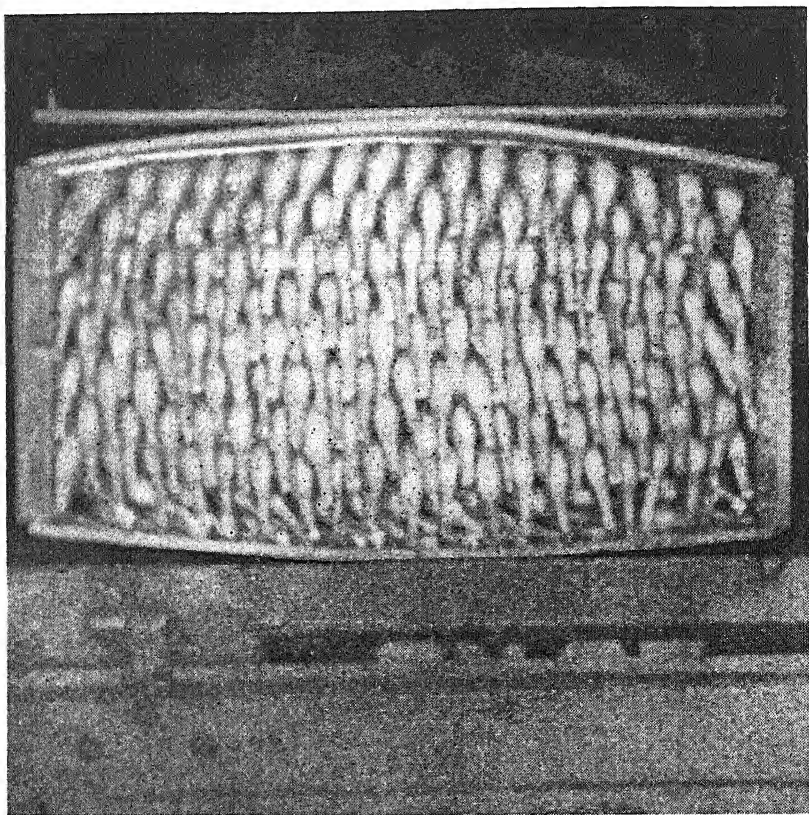


Fig. 39.—Side of case removed showing a perfect banana pack. Note the good even layers and spacing of each fruit in each layer. Also note how bulge is at bottom as well as at top of case.

Nailing Down and Wiring.

It is advisable to place a double fold of clean paper over the top layers of fruit just prior to nailing down as this will assist to avoid skin markings from the top boards.

When nailing down, the case should be placed on two blocks or suitable frame so that when the pressure is applied to the lid the pressure will be more evenly distributed through the contents of the case and part of the bulge will develop on the bottom boards.

The nailing down should be delayed as long as possible and where practicable left until just prior to removal from the packing shed.

A suitable case press or clamp should be used for this work. Do not stand, sit on the lids, or bump the case in order to settle the fruit down. If this operation cannot be handled by the case clamp without resorting to these methods it may indicate that the pack is too high. To avoid marking of the fruit

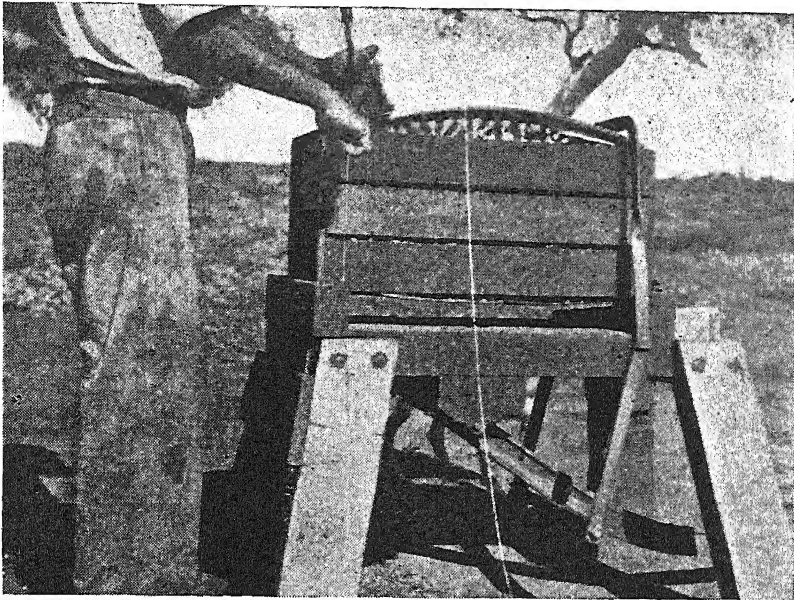


Fig. 40.—Showing correct position to apply:—A. Right hand side—case clamps and pressure. B. Left hand side—wire machine and wire.

shoulders on the side of the case when the case clamp pressure is applied some growers use pieces of tin. These are slipped down between on the insides of the case just prior to applying the case clamp and are then withdrawn once the lid has been nailed down.

The case should be strapped or wired at each end. If wires are used they should be placed about an inch in from the end of the case making sure that the wire is equidistant from the ends of the case and not on an angle before tightening. (Fig. 40.)

Frequently this important job is carelessly attended to, resulting in the wires slipping off as the bulge shrinks and eventually the lid bursts and spills the contents. Actually the wiring of the case is one of the most important operations for the wire acts as the growers final insurance of safe transport to market. The case should always be laid on its side when wiring or strapping.

Finally, neatly stencil the case, always stack on the flat, never walk on packed cases and keep the fruit cool while awaiting transport.



State Agricultural Education.

W. SOUTHERN, Principal Muresk Agricultural College.

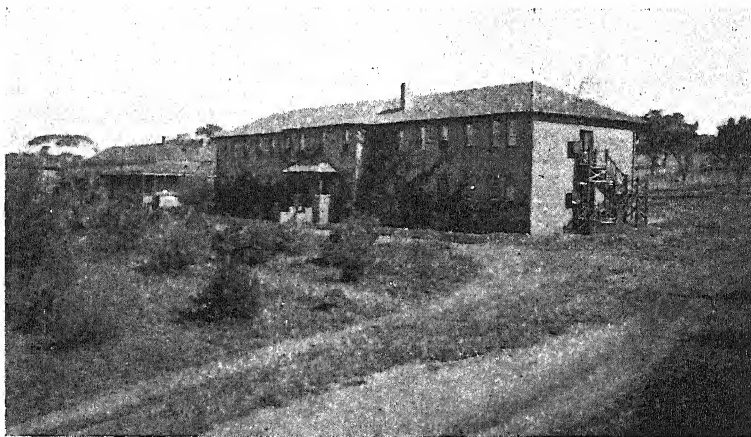
Considerable doubt appears to exist as the functions of the three State-controlled educational institutions which are concerned with agricultural training and a short review of them will be of assistance to farmers and others who are interested in the training of their sons for agricultural pursuits.

The institutions are:—

- (a) Narrogin School of Agriculture, Narrogin, W.A.
- (b) Denmark School of Agriculture, Denmark, W.A.
- (c) Muresk Agricultural College, Muresk, W.A.

The first two are controlled by the Education Department. They are of similar standard. The courses are adapted to the work carried out in each district. The Denmark school for instance, gives a good deal of attention to dairying.

The standard of education may be regarded as post-primary. Students who are aged 14-17 years are eligible for admission provided they have passed the sixth standard.



The schools afford boys from rural districts greater facilities for education, particularly along lines which will be of most value to them as primary producers. Students are given a general education and, at the same time, have the opportunity of acquiring technical skill and knowledge in handicrafts. Other subjects such as bookkeeping are also taught. Special attention is given to harness repairing, blacksmithing and carpentry.

The course is of two years duration and approximately half of that time is spent in outdoor work. Students thus secure practical instruction in various branches of agriculture.

Applications for admission must be sent to the Education Department by a fixed date each year and are invited through advertisement in the Press. A Selection Committee considers them and successful students are notified.

When applications exceed the vacancies, preference is given to the sons of farmers.

Students must be physically fitted for farm work.

The annual fee is £42 5s.

Full details including information concerning free scholarship and living away from home allowance paid to those seeking specialised education at these two schools, may be secured from the Education Department, Perth.

Muresk Agricultural College is the senior school in standard. It is this State's counterpart of Hawkesbury, Dookie and Roseworthy Agricultural Colleges and is controlled by the Department of Agriculture.

Those who desire to apply for admission must, before entering the college, have attained Junior Certificate standard. Applications close on 31st December, and the success of them is announced immediately after the Junior Certificate results are released.

Those who are competing for an Agricultural Diploma Scholarship must forward their completed application by November 30th. They must also apply for marks when entering for the Junior Certificate examination.

The certificate results are not the only means by which students are selected. It must be remembered that students in country centres may not have the opportunity to cover a large range of subjects. English and mathematics may be regarded as important. Other factors such as general interests are taken into account. It can also be anticipated that those with rural interests have a strong claim.

Students must be physically fit.

Two full time courses are normally conducted:—

(a) Diploma in Agriculture.

(b) Diploma in Dairy Science.

(a) Is a three year general course in Agriculture.

The situation of the College (three miles south of Spencer's Brook) allows most types of farming operations to be carried out. Among its activities are the growing of grain, fodder and pasture crops, dairying, pig and poultry raising, orcharding, etc. Instruction in building construction, woolclassing, blacksmithing, gardening, etc., is given.

The work is arranged so that practical work and class work are held in alternate weeks. The class courses include a wide range of subjects such as veterinary science, animal husbandry, mechanics, farm management, bookkeeping and others.

Applicants who have attained a higher standard than the Junior Certificate may be admitted to the second year of the three year course, provided that vacancies exist. Such applicants should at least have a knowledge of chemistry and physics. They are judged on their merits as well as their knowledge of the first year work.

(b) Is a course of two years and is designed to train students for employment in dairy factory work.

Application conditions, similar to those for the agricultural course apply. Holders of the Muresk Diploma in Agriculture or those who have had satisfactory factory experience and have attained a suitable educational standard, may be exempted from the first year of the course.

The Annual Fee for either course is £61 per annum.

Generally speaking, students are entitled to the living away from home allowance of £30 per annum. This allowance is paid by the Education Department.

Secondary School scholarship holders and those who gained "admissions" to Government High Schools may have their scholarship or "admission" continued at Muresk.

The following scholarships are available each year:—

(a) *Diploma of Agriculture.*

(1) "Western Mail" Scholarship, restricted to sons of primary producers.

(2) Three Department of Agriculture Scholarships

Each scholarship is of £50 annually, for three years.

(b) *Diploma in Dairy Science.*

A scholarship of the same value may be awarded to a student who has been granted first year exemption.

A special examination is held in order to assist in the selection of the holder.

The scholarships will not be awarded unless students of sufficient merit present themselves.

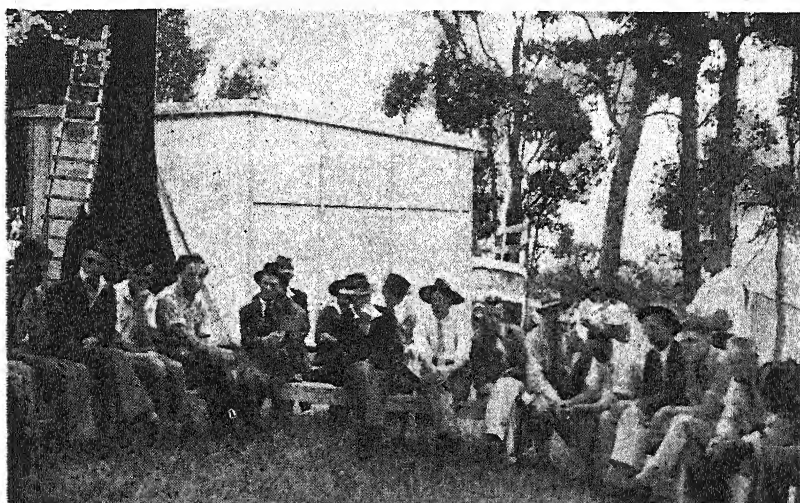
Full details, including scholarship applications, concerning the College may be secured from the Principal at Muresk, W.A. or the Department of Agriculture, Perth.

Field Days.

FIELD days are effective in bringing farmers together with a view to their gaining information regarding their problems either from an inspection of what other farmers are doing, from informal discussions, or from lecturettes and demonstrations.

The arrangement of these meetings in a farming atmosphere tends to dissipate any reserve and helps, through the informality of the proceedings, to allow all to feel as if they are contributing to the day.

The function may be carried out in one of several ways. One or two departmental officers may guide the party on its inspections and lead the discussions, or the farmers may prefer to inspect a larger number of activities with the minimum of discussion.



A group listening to a lecturette.

On some occasions a number of farms may be visited on the one day. These days serve to advertise a district and to show what individual farmers have done in overcoming their problems. The inspections are usually amplified by the various farmers describing their methods with or without explanations of principles by the leader.

It appears, however, that the most useful days are those which are arranged to allow a number of short talks by men specially qualified and who are prepared to answer questions and to stimulate discussion.

The Department of Agriculture is anxious to encourage the organisation of these days as it is realised that they are useful in extending information. It is the function of the department to help and guide the farmer with the best information regarding the practice and principles of his particular type of farming. Therefore it is anxious that Field Days be arranged as a regular feature in all districts and frequently undertakes the necessary preparations.

How to arrange a Field Day.

The first step is for some local organisation to decide that it desires a Field Day to be held to demonstrate some particular aspect of farming.

A date or dates should be determined tentatively while a decision is necessary also-regarding the location of the proposed function.

A letter should then be forwarded to the Department of Agriculture stating that a Field Day is wanted at the selected place and time. An indication should also be given of the main topics it is desired should be discussed.

It is wise to enlist the aid of the district officer who, if unable to assist directly in the preparations, may be able to guide the organisers. He may be in a position to finalise arrangements on behalf of the local body, so that the appropriate officers may be in attendance.



Informality in proceedings is the key-note.

A local farmer should be appointed to act as chairman to arrange for the welcome of visitors and the announcement of the programme and other features. If the function is to commence in the morning provision should be made for light luncheon or for hot water and shelter for picnic parties. Frequently bodies such as the Red Cross or the Country Women's Associations will look after the catering arrangements.

Organisation on the Appointed Day.

As the success of the gathering will depend largely on its informal character, the most convenient assembly point for visitors should be chosen. From there the introduction of the leaders for the day takes place, and from that point the direction of the proceedings may continue with a local representative or be given to an officer.

Before this stage is reached, however, a discussion between the local organisers, the farmers owning the property and the officers will have determined the programme.

Naturally the best scheme is to have a property on which the various phases of farming to be discussed are well represented and the assembly moves from point to point so that each talk is given in the proper atmosphere. For example a talk on the herd sire would take place after an inspection of the bull—or a discussion on sheep would develop during an inspection of the flock or of the sheep yards and dip. Pig raising would be the subject for consideration during an examination of the brood sows and the boar and their accommodation.

In this way interest is maintained as the gathering does not tire from standing or sitting in one place. There are short breaks between lecturettes for examination of premises or stock, or during the walk to the next point.



The aid of women's organisations make for a successful day.

A careful arrangement of the order of lecturettes and so also of the route of inspection to diversify the programme is useful. For example it is advisable to discuss the herd, dairy premises, the bull, calf feeding, not one immediately after the other, but interspersed with other topics, e.g., pastures, stock diseases, water supplies, general surveys of the various industries.

A number of speakers also stimulates interest providing any one is not expected to take too many periods in a short space of time.

Talks should be short and directed as far as possible on aspects of farming illustrated on the property. They should be of such a nature that they stimulate questions from the listeners. Speakers should complete their remarks well within their time allowance so that there will be time for a discussion.



Catering plays an important part in the day's activity.

Illustrations of programmes of field days in the dairying areas are given hereunder.

a.m.

- I. 11.0 Assembly.
Introduction by chairman.
Reply by senior officer A with outline of programme.
- 11.10 Dairy Premises Officer B.
- 11.30 Pasture establishment and species—Officer C.
- 11.50 Dairy Herd—Officer A.

p.m.

- 12.10 Diseases of Cattle—Officer D.
- 12.30 Lunch.
- 1.15 Survey of present position Dairying Industry—Officer A.
- 1.40 Dairy Hygiene—Officer B.
- 2.5 Pasture Management, Hay and Silage Making—Officer C.
- 2.30 Diseases of Pigs—Officer D.
- 3.0 Pig Raising—Officer A.
- 3.20 Herd Recording—Officer C.
- 3.45 Questions, General—All Officers.
- 4.0 Afternoon Tea—Disperse.

a.m.

- II. 11.0 Assembly and introduction by chairman.
Reply by Senior Officer with outline of programme.
- 11.10 Farm Water Supplies.
- 11.30 Bulls—Selection of and Management.
- 11.50 Pastures Establishment and Management.
- p.m.
- 12.15 Machinery Demonstration.
- 12.40 Lunch.

p.m.

- 1.30 Irrigation.
- 1.50 Cattle Diseases.
- 2.15 Feeds and Feeding.
- 3.5 Pigs.
- 3.25 Fertiliser Problems.
- 3.45 General Questions.
- 4.0 Afternoon Tea and Disperse.

III. In mixed farming areas other topics than dairying can be included, i.e. :

a.m.

- 11.0 Assembly—Introduction, etc.
- 11.10 Inspection of Premises and Talks.
Dairy—Sheep Yards and Shearing Shed.
- 11.40 Pasture Establishment and Management.

p.m.

- 12.0 Management of Sheep and Fat Lambs.
- 12.20 Dairy Hygiene.
- 12.40 Lunch.
- 1.25 The Dairy Herd and Herd Sire—Selection and Management.
- 1.50 The Vegetable Garden.
- 2.10 Fodder Conservation.
- 2.30 Hay Baling Demonstration.
- 3.0 Cattle and Sheep and Pig Diseases.
- 3.30 Pig Raising.
- 3.45 Question Time.
- 4.0 Afternoon Tea and Disperse.

Summary.

- a. Field days must be informal.
 - b. They should be organised to allow movement to inspect various features of the farm.
 - c. Speakers should be as numerous as can conveniently be arranged.
 - d. Talks should be short and simple.
 - e. Talks should be related to practical and topical problems.
 - f. Questions and discussion should be encouraged.
-

Various Means of Distribution of Water on the Dairy Farm.

J. T. McNALLY, Dairy Adviser.

THE necessity for a continuous supply of water at the dairy premises has been more forcibly brought to the notice of dairy farmers since the economic value of milking machines has been recognised and the installation of these plants has become so popular.

For the successful dairy man adequate water supplies with efficient means for economical distribution are of the utmost importance, therefore, every dairy should possess equipment that will provide this essential need.

The most economical source of water supply is the storage of rain-water from the sheds and buildings. Unfortunately, this usually consists of a small galvanised iron rain-water tank connected to the dairy sheds which is purely dependent on the quantity and continuity of rain to supply sufficient water. This is satisfactory during the wet winter months but as the spring advances there is a tendency to ease up on the use of the stored water and the dairy hygiene deteriorates accordingly.

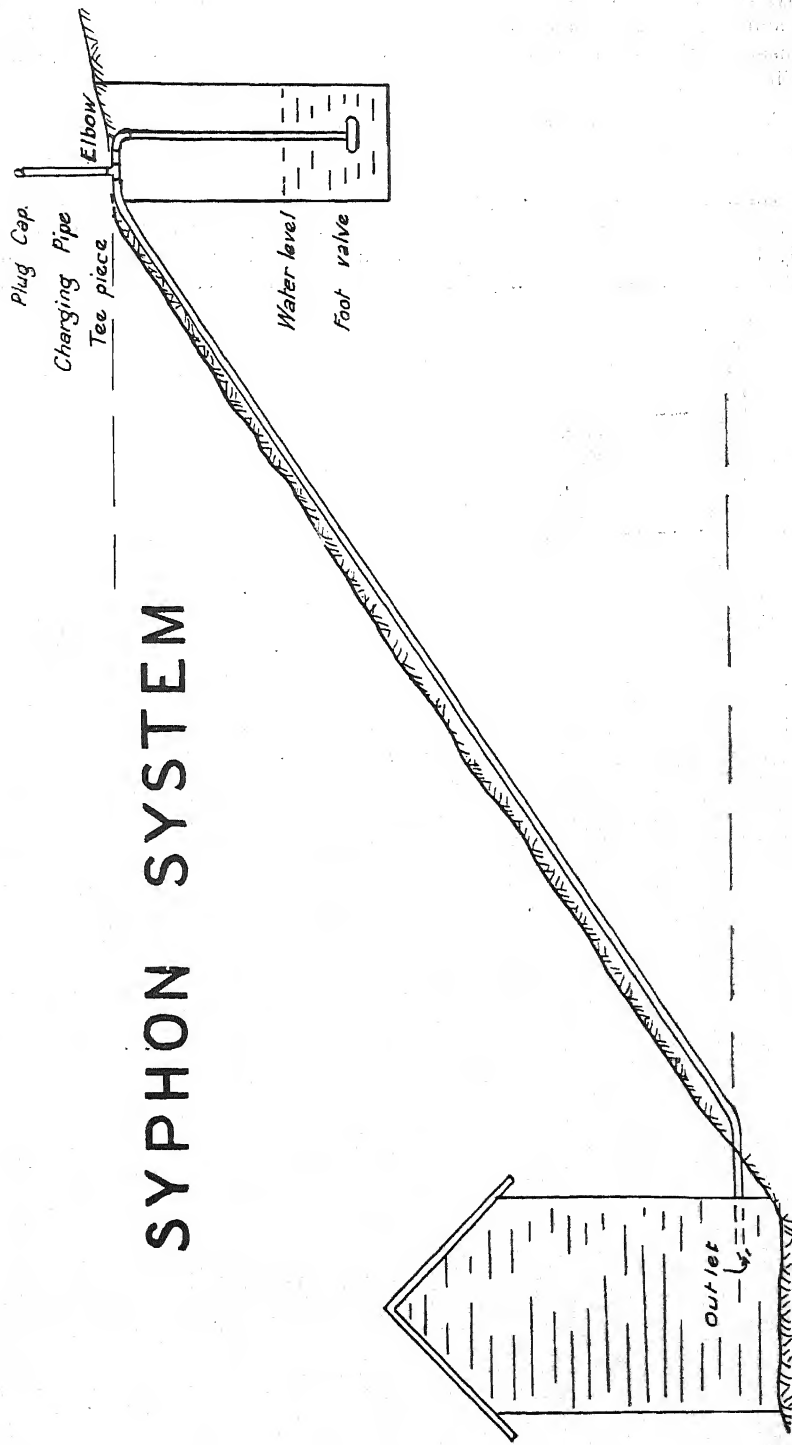
To take full advantage of the annual rainfall adequate storage is essential. In this connection the large concrete brick circular tank usually from 6,000 to 10,000 gallons capacity, if built correctly, is very satisfactory and holds sufficient water for the average dairy for a considerable time. The cost varies according to the availability of materials. In some districts tanks have been built at a total cost of from £35 to £60. The main essential in constructing this type of storage tank is to have solid foundations, clean materials and a knowledge of concrete construction. The average farmer should employ a tradesman well versed in this work, as a sound job pays dividends.

In hilly districts some excellent supplies of water have been found on the higher reaches of the hills above the dairy premises. Where the surface of the water is above the dairy level and yet below the ground level at the well, a syphon can be successfully used to supplement the storage tank or be used direct.

In installing this system several points are essential for successful results.

1. The level of water in the well must be above the point of delivery, the greater the vertical distance the more efficient the delivery.
2. All joints, pipes and fittings must be pressure tight.
3. Keep inlet pipe well below surface of water.
4. An air lock can be caused by the heat of the sun releasing gases in the water, which rise to the highest point in the pipe line. This occurs most frequently in systems which are not in constant use. It is advisable to place pipes underground as a guard against this possible trouble.

The pipe leading from the well should be fitted with a foot valve and strainer and a tee piece inserted alongside the elbow fitted at the surface of the ground. To this tee piece a suitable length of pipe can be connected verti-

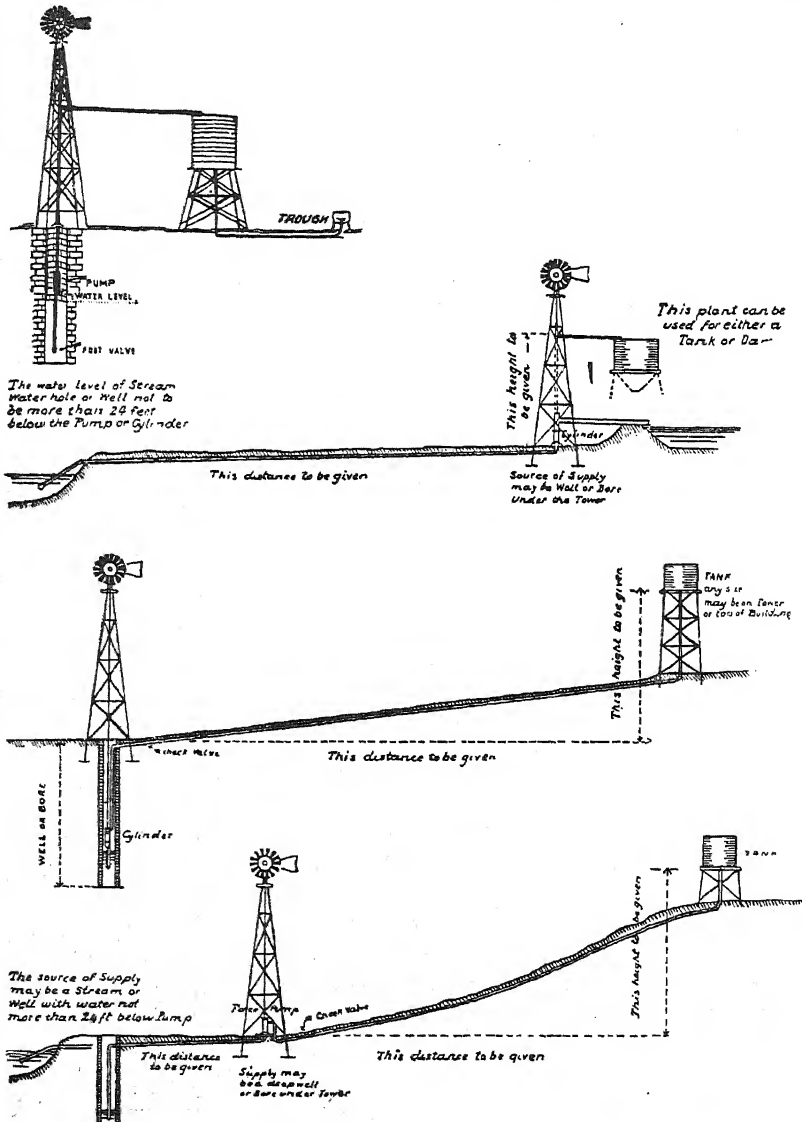


SYPHON SYSTEM

eally, through which the whole system can be filled with water, then plugged up and if gas tight, water will be available at the point of delivery. On rare occasions when an air lock occurs it is rectified by unscrewing the plug and refilling the pipe.

The plan on page 149 gives an outline of the system operating on a farm in the South-West.

On a number of hillsides springs and soaks have been found to exist. These are a valuable source of supply and if above the dairy premises can be economically brought into use by sinking a wooden or concrete box at the point of outlet of the water, protecting it from stock and connecting to the dairy with



pipng. As an alternative a tank can be placed just below the soak, or near the point of delivery, as a reservoir and then connected with the dairy. This has the added advantage of creating a reasonable force and is adaptable for hosing.

Wells and bores are a very valuable source of supply of water. Various methods are in use for raising the water, varying from the bucket and rope to the power driven pump. Any system which entails manpower is usually irksome, is used only when absolutely necessary, and then to a minimum extent. The semi-rotary and Douglas pumps are efficient and if manpower is available can be effectively utilised.

With water available in bores, wells, dams, still water streams, fast or slow moving streams the windmill has proved very efficient. This economical means of water pumping has been used for many years and modern engineering has improved it so that few other methods can compare with it. For best results the mill should be high enough and the surrounding country sufficiently clear to allow full use of prevailing winds. In the accompanying diagram various layouts for windmills are demonstrated showing the adaptability of this equipment.

Windmill Capacities.

The figures given below are based on a wind velocity of 12 to 15 miles per hour, and with speed regulators, with which well known mills are fitted, set to give the number of strokes per minute shown on table. It should be understood that the proposed mill site is one favourable for wind.

Table showing approximate capacities (per hour) of well known windmills working against different heads and also showing size of pump recommended for each head.

Size of Mill and Pattern.	Length of Stroke.	No. of Strokes per min.	Total Head in Feet.				
				25.	50.	75.	100.
6 ft. Single Crank ...	6½ in.	30	Pump Cap	2½ in. 175	2 in. 115	1½ in. 65	......
8 ft. Single Crank ...	6½ in.	30	Pump Cap	2½ in. 200	2½ in. 175	2 in. 115	......
6 ft. Planetary Crank	5½ in.	30	Pump Cap	2½ in. 140	2 in. 100	2 in. 90	......
8 ft. Planetary Crank	5½ in.	25	Pump Cap	3 in. 170	2½ in. 120	2 in. 90	2 in. 75
10 ft. Planetary Crank	6½ in.	22	Pump Cap	4 in. 330	3½ in. 250	3 in. 185	2½ in. 140
8 ft. D. Geared Crank	6 in.	30	Pump Cap	3½ in. 320	3 in. 200	2½ in. 160	2 in. 120
10 ft. D. Geared Crank	7 in.	25	Pump Cap	4 in. 400	3½ in. 310	3 in. 225	2½ in. 180

For areas where the use of the windmill is not suitable, the power driven pump can be adapted to give excellent results. There are a number of different types of pumps, but where the water supply is adequate and conditions suitable, the centrifugal pump is recommended.

The efficiency of this pump is based on the size and speed of the impeller, the suction head, and the distance from the source of supply. One of the main features of installing a centrifugal pump is to place it as near to the water as practicable and never more than 15 ft. vertical distance. The delivery pipe should be the next size larger than the pump outlet to reduce friction. All joints including the stuffing box on pump should be air tight and the pump driven at the number of revolutions recommended by the manufacturers.

Various sources of power can be utilised, such as a direct coupled electric motor, belt driven from a stationary engine or a mobile engine such as is used for a power saw. When considering installing a unit of this description, give full particulars to your supplier and follow the advice of the experts who are generally available for guidance in these matters.

However, the accompanying table will give the approximate particulars of power required, revolutions and the capacity per hour. The head refers to the vertical height from the source of supply to the delivery plus friction from the pipe line.

Approximate Table of revolutions per minute and horse power required when using Ball-Bearing Centrifugal Pumps against total heads of 10 to 100 ft. at rated capacity—Gallons per Hour.

SINGLE STAGE 1½ IN. PUMP STANDARD TABLE.

Revs.	Head.	Gallons.	B.H.P.
1,330	10	2,200	.5
1,475	20	2,200	.6
1,790	30	2,200	.75
2,040	40	2,200	.9
2,275	50	2,200	1.2
2,300	30	4,100	2
2,300	40	3,600	1.75
2,300	50	2,880	1.75
2,300	60	2,200	1.5
2,850	50	4,800	3.3
2,850	60	4,100	3.1
2,850	70	3,200	3
2,850	80	2,880	2.4
2,850	90	1,440	2
3,400	60	5,000	5
3,400	70	5,000	5
3,400	80	4,800	5.25
3,400	90	3,600	5.24
3,400	100	2,880	4.75
3,400	110	2,400	4

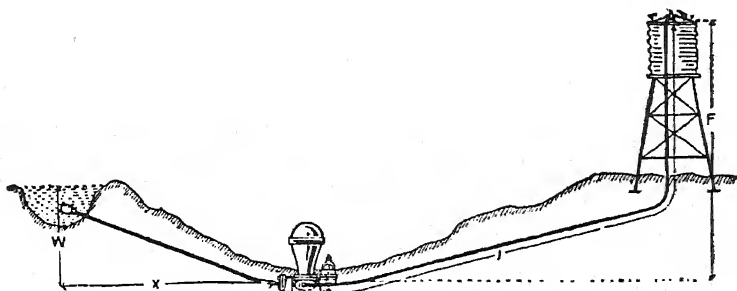
SINGLE STAGE 2 IN. PUMP STANDARD TABLE.

1,100	10	3,300	1
1,250	20	3,300	1.1
1,420	30	3,300	1.5
1,610	40	3,300	2
1,780	50	3,300	2.4
1,975	60	3,300	3.1
2,100	70	3,300	3.9
2,200	50	7,500	5.5
2,200	60	7,200	5.25
2,200	70	6,000	5
2,200	80	4,100	5
2,200	90	2,100	4

TWO STAGE 1½ IN. PUMP STANDARD TABLE.

2,560	...	...	20	5,760	4.5
2,560	...	...	30	5,000	4.1
2,560	...	...	40	4,700	4
2,560	...	...	50	4,100	3.8
2,560	...	...	60	3,900	3.7
2,560	...	...	70	3,600	3.6
2,560	...	...	80	3,200	3.4
2,560	...	...	90	2,600	3.25
2,560	...	...	100	2,400	3
2,560	...	...	110	1,800	3
2,560	...	...	120	1,320	2.7
2,750	...	...	50	5,000	5
2,750	...	...	70	4,250	4.5
2,750	...	...	100	3,600	4.25
2,750	...	...	110	3,000	4.5
2,750	...	...	130	2,500	4.25
2,750	...	...	140	1,500	4.25
2,750	...	...	150	1,720	6
3,150	...	...	100	4,800	6.5
3,150	...	...	110	4,100	6.25
3,150	...	...	120	3,600	6
3,150	...	...	130	3,200	6
3,150	...	...	140	3,000	6
3,150	...	...	150	2,880	6
3,150	...	...	160	2,040	6.5

Where farms are situated adjacent to running streams one of the simplest units for getting the water to a height considerably above the source of supply is the hydraulic ram. This is a self acting pump which utilises the momentum of a slight fall to elevate water many times the height of the fall used to operate the unit.



Hydraulic Ram. W—Vertical height (or fall) from source of supply to Ram. X—Distance in which fall is obtained. F—Vertical height from Ram to point of discharge.

The hydraulic ram must be set below the level of the supply. The water acquires a constantly increasing velocity in its downward course from the supply to the ram until it is suddenly stopped by the closing of the impetus valve. Its only chance for escape is through the inside valve, which opens into the air chamber; the air in this chamber is compressed by the blow sufficiently to allow a portion of the water to enter.

The air immediately expands and recovers again its original volume. This action closes the inside valve and compels the excess of water to escape through the discharge pipe which has now become the only means of exit.

Up to 90 per cent. of the water runs to waste through the impetus valve.

When the impetus valve rebounds, the water in the drive-pipe is again allowed to acquire velocity by washing around the valve, the friction of the water again raises the valve and the process is continued as before.

The fall, or vertical distance from the surface of water in the supply reservoir to drive opening in the ram, must be not less than two feet (as this is the lowest head under which a ram will work satisfactorily).

The discharge elevation, must be not less than six times nor more than twelve times the fall. Should the discharge elevation be less than six times the fall, this condition may be corrected by installing a valve in the line and throttling it so as to produce the required back pressure by restriction. The drive or supply pipe should be placed at an angle of not more than thirty degrees to give the best results and as a general rule the length should not be less than three-quarters of the height to which the water has to be raised. The length may, however, be much greater than this where it is necessary in locating the ram to obtain the desired amount of fall.

The table below will give the approximate efficiency of the hydraulic ram.

TABLE SHOWING APPROXIMATE EFFICIENCY OF WELL KNOWN HYDRAULIC RAMS.

Minimum fall of water, in feet, under which ram will effectively elevate water to height given below	2	2	2	3	4	5	6	7	8	10	12	15
Height in feet, the water may be elevated	4	6	8	15	24	35	48	63	80	100	120	150
Length of drive pipe, in feet ...	12	12	12	15	20	30	40	50	60	75	95	110
Number of times the height or elevation of discharge is greater than the fall	2	3	4	5	6	7	8	9	10	10	10	10
Proportion of water elevated or discharged by the ram ...	2/7	1/5	1/7	2/17	1/10	1/12	1/14	2/31	1/17	1/18	1/20	1/25
Proportion of water wasted at the impetus valve by the ram ...	5/7	4/5	6/7	15/17	9/10	11/12	13/14	29/31	16/17	17/18	19/20	24/25
Per cent. of useful effect of power expended	80	78	75	72	68	62	57	53	48	43	38	35

In compiling this article an endeavour has been made to bring before dairymen generally an easy and efficient method of making available at the dairy premises sufficient water for the carrying out of the required routine in keeping the plant in an hygienic condition. Not only is sufficient water available for this purpose, but, on most holdings, the source of supply is ample to allow an efficient cream or milk cooling system to be installed, which is essential for a high quality product, and also give a reasonable surplus for stock.

ACKNOWLEDGMENTS.

Thanks are expressed to Messrs C. George and Walter Wilson for assistance in compiling this article.



1947 Grasshopper Conference.

By C. F. H. JENKINS, Government Entomologist.

INTRODUCTION.

THE most serious grasshopper outbreak in the history of Western Australia occurred in 1937 when widespread damage was done in many parts of the outer wheatbelt and the pest encroached into some of the older established agricultural districts.

In subsequent years, the severity of grasshopper plagues has fluctuated with seasonal conditions but the pest is regarded as one of the most serious threats to agriculture in the lighter rainfall areas.

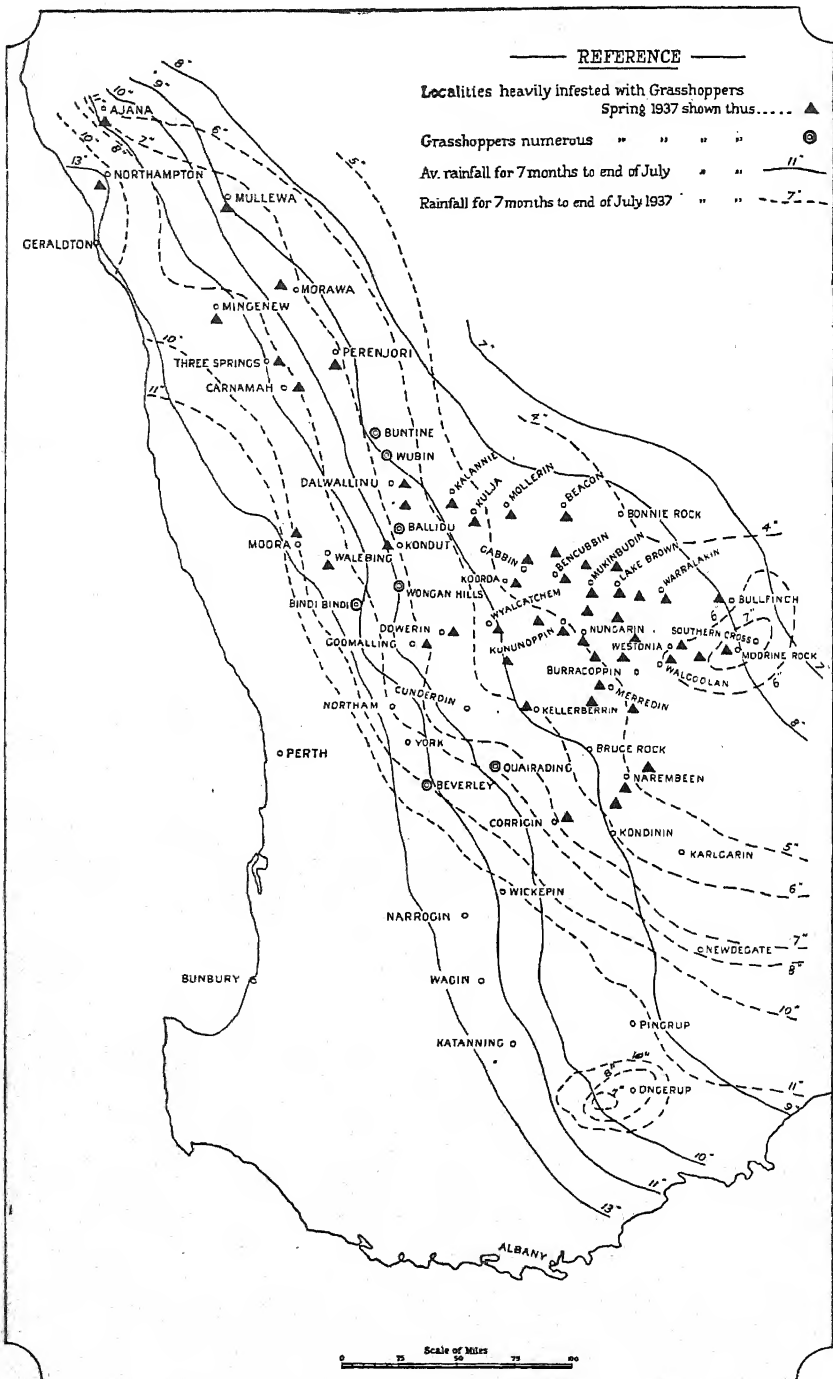
In 1942 the then Minister for Agriculture (Mr. F. J. S. Wise) convened a Conference of farmers' representatives and Government Officers to discuss the "Rehabilitation of the Marginal Areas with Particular Attention to the Grasshopper Menace." A comprehensive report was submitted dealing with all aspects of marginal area rehabilitation and setting out a long term policy for grasshopper control.



Typical grasshopper country, north-eastern wheat belt.

The 1947 Conference was arranged to review the findings and results of the earlier Conference and to make additional recommendations considered advisable.

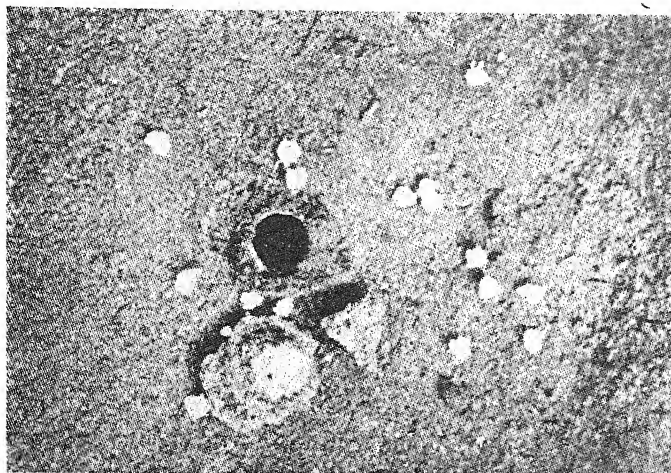
The gathering comprised officers of the Rural and Industries Bank, Department of Agriculture and farmers' representatives and was opened by the Under Secretary for Agriculture (Mr. G. K. Baron Hay) on February 26th.



Distribution of grasshopper swarms in 1937.

GRASSHOPPER OUTBREAKS SINCE 1942.

In reviewing grasshopper outbreaks since the last Conference held in 1942, it was stated that, although the insects had been numerous and widely scattered during several seasons, no widespread damage has been done and that the past control policy had played an important part in bringing about this satisfactory state of affairs. It was announced that, during the last five years over £36,000 had been expended by the Government on control measures and that under the scheme approximately 217,000 acres on occupied and reverted holdings had been broken up to prevent the hatching of grasshopper eggs.



Hatched egg-pod of the small plague grasshopper showing soil cap and moulted "skins" of nymphs.

(After A. D. Cocks.)

Delegates were agreed that the extensive ploughing operations carried out in the past 10 years had greatly assisted in preventing major grasshopper outbreaks in the outer wheatbelt. In connection with grasshopper ploughing in recent years, it was pointed out by Mr. Austen (Rural & Industries Bank) that the proportion of reverted to occupied holdings had diminished greatly in the last year or so because under the recent reconstruction policy, many previously abandoned holdings had been linked to neighbouring occupied farms.

CHIEF RECOMMENDATIONS DISCUSSED.

(a) *Central Representative Advisory Committee.*

Delegates considered that periodic meetings of such a Committee would be very beneficial.

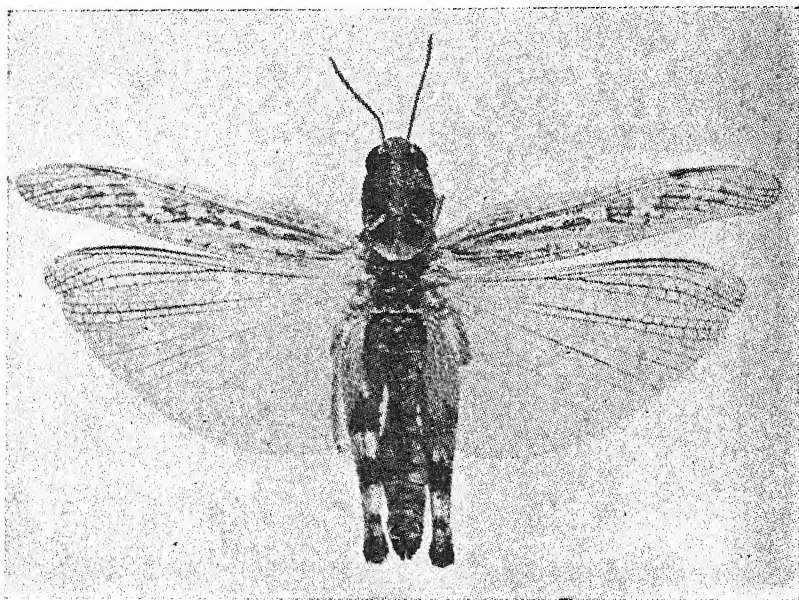
No set meeting times were specified as it was felt that these could best be left to the discretion of the Department of Agriculture.

(b) *District Advisory Committees.*

Although certain District Committees had shown little interest in assisting in grasshopper control, it was considered that in many areas these committees served a very useful function and that an effort should be made to stimulate the work of these bodies in the future.

To this end, it was suggested that the Secretary of each Road Board concerned should arrange meetings between the District Advisory Committee and the Rural & Industries Bank Inspector in order that the plotting of infested areas might be discussed as well as other problems.

It was also considered very essential that officers of the Entomological Branch should keep in personal touch with the District Committees and that occasionally combined meetings of these Committees should be called at suitable country centres and that an Entomologist should attend.



The small plague grasshopper.

(After A. D. Cocks.)

(c) *Division of Wheatbelt into Zones A, B, C, according to liability of Grasshopper Attack.*

Zone A. Unaffected or lightly affected established farming localities in the north-eastern districts west of the badly affected areas.

Zone B. The area between Zone A and a line parallel to and five miles east of the Rural & Industries Bank's marginal line, the width of this zone varying from 10 to 25 miles.

Zone C. The area east of Zone B to the limit of development for farming purposes.

The foregoing zones as defined by the 1942 Conference were approved after some discussion as to whether a portion of Zone C could be added to Zone B.

(d) *Ploughing of Breeding Grounds.*

The cultivation of breeding grounds to be commenced in Zone B and extended to Zone A and C to the extent to which funds, equipment and manpower will permit.

This was agreed to in principle and will be discussed in greater detail under the heading of *Future Control Measures*.

(e) *Poison Operations.*

These to be supervised by the Department of Agriculture and local authorities.

The farmers' representatives spoke strongly concerning the effectiveness of poisoned bait and considered that it should be more widely used especially to deal with isolated outbreaks and on country not suited to cultivation.

(f) *Control of Operations.*

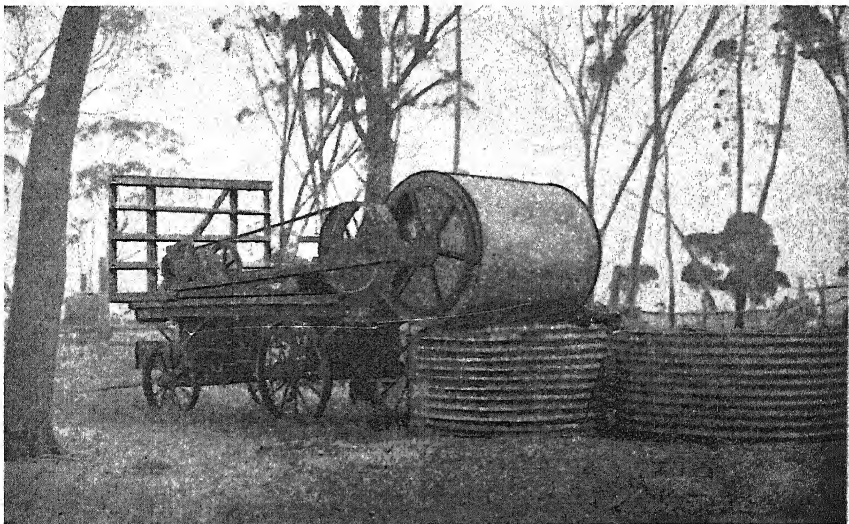
The Rural & Industries Bank with the assistance of the Department of Agriculture to control the field operations against the grasshopper.

It was considered that this system had worked very satisfactorily but that there should be more field work done by entomologists.

(g) *Experimental Work.*

For a number of years efforts have been made by the Department of Agriculture to discover suitable pastures which would render unnecessary the repeated cropping of areas of the outer marginal districts where properties are used for stock only.

The Chairman announced that investigations along similar lines were being carried out in South Australia where a grasshopper problem existed very similar to our own. He stated that he had visited much of the area in question in 1945 and had discussed all aspects of control with Entomologists and Agrostologists of the Waite Agricultural Research Institute. Mr. Thomas (Department of Agriculture) stated that while little progress had been made in developing anything in the nature of a permanent pasture for the dry wheat area, very promising results had been obtained with Greenough Barley and Wimmera Rye, both very early maturing varieties. Seed was at present in short supply but this was being bulked at the Research Stations.



Power driven bait-mixer used at Narembeen in 1936.

FUTURE CONTROL MEASURES.

Ploughing. Recommended that Government assistance be continued for ploughing on unoccupied and on occupied holdings.

Reverted Holdings.—Ploughing to be done by contract as in the past.

Occupied Holdings. (a) Government assistance to apply only to grasshopper ploughing done in excess of the normal fallow.

(b) Farmers to be required to adhere to a five years rotation as set out hereunder. This would ensure that all cultivable land is broken up every three years.

Five Year Rotation.

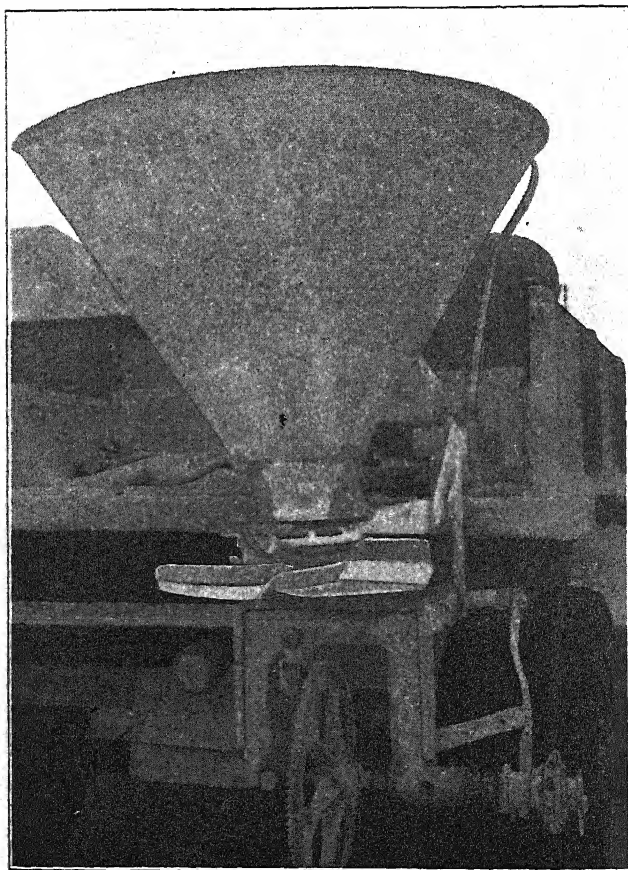
Fallow.

Wheat.

Oats and Wimmera Rye.

Pasture.

Pasture.



Super spreader adapted for bait distribution.

(c) Subsidy to be available annually until all cultivable land on the farm has been broken up under the rotation. It was considered that the area would then be free from grasshoppers and that the responsibility to continue and finance the rotation should then rest with the farmer.

Summer Ploughing. It was decided that summer ploughing should be recommended in those areas where it was considered practicable by the district Rural Bank Inspector or other responsible officer.

Poison Baiting. It was recommended that an endeavour should be made to stimulate the use of poison bait by circulating Road Boards and pointing out the necessity of controlling isolated outbreaks on land unsuitable for cultivation. In some cases the neglect of such areas led to the re-infestation of adjacent ploughed land.

Plotting of Egg Laying Areas. It was recommended that:—

- (a) The present system of plotting egg laying areas be continued, the infested areas to be plotted as accurately as possible.
- (b) The Rural Bank Inspector and the District Advisory Committee confer before submitting the final map so that the relative importance of various breeding grounds could be discussed.
- (c) An Entomologist be available in the field during the main egg laying period.

Research. It was recommended that:—

- (a) Experiments be continued with the new insecticides D.D.T. and 666 both for baiting and spraying.
- (b) That inquiries be made from the R.A.A.F. regarding the availability of planes and trained personnel in this State equipped to undertake aerial spraying.
- (c) The whole subject of aerial spaying to be thoroughly investigated to determine whether it would be applicable under local conditions.

Bathurst Burr.

A SERIOUS NOXIOUS WEED.

C. A. GARDNER, Government Botanist.

G. R. W. MEADLY, Weeds Officer.

RECENT reports of Bathurst burr from Narembeen, Donnybrook and Midland Junction draw attention to the ever present risk of this serious weed becoming established in the agricultural areas of Western Australia. Bathurst burr first appeared at Twofold Bay in New South Wales in the forties of last century, being introduced to Australia in the tails of horses imported from Valparaiso, South America. A few years later it was reported from Bathurst and since has spread over a large area in New South Wales, besides becoming a serious weed in other States. In Western Australia, the main areas of infestation are located in the Eastern Goldfields district, centred on Kalgoorlie and Coolgardie while restricted occurrences have been reported from a number of places ranging from Geraldton to Albany including the Metropolitan area.



Bathurst Burr (*Xanthium spinosum* L.).

Explanation of Plate.

A—Portion of branch with lateral branchlets. B—Young leaf and spines.

C—Fruit or "burr."

Although Bathurst burr is well known to farmers and pastoralists in the Eastern States, it is not as readily recognised by the man on the land in Western Australia owing to its limited occurrence in this State. The accompanying drawing will assist greatly in the recognition of this weed. It is a rigid, much-branched annual of 1 to 2 feet in height with greenish-yellow stems which bear leaves that are dark green above but pale underneath. These leaves are usually three lobed with the central lobe longer than the other two and bear at their bases rigid three pronged spines. The flowers are inconspicuous and are succeeded by brown egg-shaped burrs of about one half inch in length. These are covered with fine hooked bristles along with two short straight horns at the apex. The plant is essentially a summer-growing annual but seeds germinate and plants mature out of season, thus adding to the difficulties of control.

Losses caused by Bathurst Burr.

There is some evidence to indicate that Bathurst burr is harmful to stock at certain stages of growth but the spiny nature of the plant renders it unattractive and it is seldom eaten. The characteristic which has made it such an undesirable weed is the tenacious nature of the burrs. These readily become attached to clothing, bags and farm animals, especially sheep and when thoroughly entangled their removal is not a simple matter. From a commercial viewpoint sheep present the greatest problem as their fleeces provide a very receptive surface for the hooked burrs. When the weed is abundant the burrs become massed in the wool thus depreciating its value, as contaminated wool requires special treatment following scouring. The direct and indirect loss to Australia amounts to many thousands of pounds annually.

Bathurst burr presents a major problem in Europe, Asia, Africa, America and Australia. Such a situation does not come about by chance and it is interesting to examine the characteristics of the plant which are conducive to its prominence as a weed in many countries. Firstly, it is not unduly limited by climatic requirements and has the capacity to develop from a seedling to a seed bearing plant in a few weeks; secondly the two seeds in each fruit are capable of retaining their viability for long periods, although if conditions are favourable one usually germinates in the first season and the other remains dormant for an indefinite period; and thirdly the hooked appendages could scarcely be improved as a medium for assisting distribution.

Much has been written concerning the efficiency of the Cossack cavalry but they played another role at the beginning of the nineteenth century as indicated by the following description of the spread of Bathurst burr through Europe from the East—"In 1828 it was brought into Rumania by the Cossack horses whose manes and tails were covered with the burrs. It travelled in Hungarian wool, and in cattle from the same country to Regensburg, and on to Hamburg, appearing here and there on the way."

Legislation.

As already mentioned, with the exception of isolated occurrences in the agricultural districts, in this State Bathurst burr is limited to the Eastern Gold-fields area. Sites from which the weed has been reported are inspected at appropriate intervals and regulations have been made under the Noxious Weeds Act to control the movement of stock from the main infested areas in order to reduce the chances of spreading to a minimum. Stock, especially sheep, imported from the Eastern States have been responsible for most of the outbreaks in this State and in consequence it is now necessary unless a special permit is secured,

to shear all imported sheep immediately prior to or after arrival in this State. Burrs present are usually removed with the fleece and any remaining are easier to detect in the short wool.

Methods of Distribution.

Although we can attribute most of the occurrences to burrs carried by animals our own experiences have proved that this is by no means the only way in which Bathurst burr is distributed. Agricultural seeds have always presented a ready medium for the dissemination of weed seeds but as the seeds of Bathurst burr remain enclosed in comparatively large fruits the risk of their remaining in crop seeds would appear to be small. This is essentially true but during machining the hooked spines are removed and the smooth fruits containing seeds have been found in large agricultural seed such as Sudan grass.

On one occasion a single plant was found growing in a market garden at Wanneroo. There is every reason to believe this was introduced along with some blood and bone—not in the fertiliser itself but attached to the bag. There is little or no chance of a burr surviving the drying and crushing treatments involved in the preparation of blood and bone, but there is a chance of an odd burr becoming attached to a bag while at the abattoirs.

The possibility of the unusual must always be considered in the case of this and similar burrs. Unwittingly some commercial enterprises have spread this weed in a novel but at the same time most harmful manner. Firms have advertised their goods by means of printed card butterflies, the body of which is a burr. These butterflies, when thrown, adhere to clothes and hair. Little imagination is needed to appreciate the large distances seeds may be carried by this means. Within recent years it was necessary to suppress such activities in this State but the adhering portion then consisted of the burr of burdock, another serious weed.

The war in the Pacific resulted in some unusual cargoes originally bound for other destinations reaching Australian ports and one of the strangest of these might have proved very costly. While other goods were being examined in a bond store at Fremantle by an officer of the Department of Agriculture some Bathurst burrs were noticed on the floor. A closer examination revealed that they had been spilt from a hole made by rats in a large container measuring some 4 feet by 4 feet by 5 feet. As the orientals attribute some medicinal properties to the burrs we can only assume that they had been consigned for that purpose. Hundreds of thousands of burrs likely to be distributed by rats and other means is not a happy thought even in a country where the weed is plentiful. Their value as a curative of human ills would have needed to compare favourably with that of penicillin to have saved them from immediate destruction in the incinerator.

Flood waters have proved a significant distributing agent particularly in the case of intermittent waterways. Plants become established in moist depressions which provide ideal conditions and then, following rains, the burrs are swept along the course of temporary rivers. This sequence of events is demonstrated on a large scale in New South Wales, but is also quite apparent on the flats and along the gullies in the vicinity of Kalgoorlie and Coolgardie.

Control.

When considering control, as with all weeds, early recognition followed by prompt action is the soundest advice that can be given. The importance of recognising a weed before it becomes thoroughly established cannot be over-

stressed and this applies particularly to Bathurst burr in the Agricultural areas of this State, for, with one exception, in no district have more than a few plants been located. When plants are found they should be dug carefully so that no burrs become detached and any burrs on the ground should also be gathered. The entire material should then be destroyed by burning. Where only one or two plants are found it is advisable to build the fire over the place from which they were removed. By this means any burrs left on the ground are unlikely to escape. The outcome of not carrying out such work in a thorough manner was clearly demonstrated during a recent inspection of an affected area. Two large plants some thirty inches in height and bearing possibly 100 burrs each had been grubbed only to be thrown into a dry open drain. This action would have served to spread rather than control the weed as the drains in this area run freely following rains. Even when all plants have been destroyed the site must be kept under observation for a number of years owing to the longevity of the seeds.

If there is any doubt concerning the identity of weeds, specimens should be forwarded to the Department of Agriculture for identification. Even in cases where serious weeds such as Bathurst burr are recognised by farmers, the Department is keen to have information concerning their distribution.

Further Notes on Mechanical Clearing.

CLEARING FOR FLAX COMMISSION AT BEELERUP WITH D.7 TRACTOR AND ANGLEDZOZER.

Foreword by M. Cullity, Superintendent of Dairying.

Large bulldozers owned by the Public Works Department have been used for the past twelve months in the Mt. Barker-Narrikup area in clearing land for private farmers, and although only one machine has been in operation for the greater part of the year, over 3,000 acres have been treated preparatory to burning. The machines are controlled, operated and maintained by the Public Works Department while organisation of itineraries, collection of farmers, payments, etc., has been the responsibility of the Department of Agriculture. Information regarding the type of country cleared, the cost of bulldozing and ultimate cost of completing clearing and sowing of pastures is being collected and will be published in future issues of this journal. Reference has already been made ("Journal of Agriculture," Vol. XXII, No. 1, March 1945) to demonstrations carried out in the early part of 1944. Farmers' opinions on those trials suggested that the cost of knocking down was not more than one third of the cost of mullenising by hand. It was agreed that as the bulldozer removed the greater number of trees by their roots that a far better job was done than could be expected by hand. In some cases up to 95 per cent. of the trees were so treated.

On the basis of farmers' statements of estimated cost of clearing by hand it was estimated that the work carried out by one D7 machine in three months (with much waste time travelling) could not have been equalled by fifty men.

It will be appreciated therefore that the effectiveness of these machines should not be measured solely in terms of cost, but also by the speed with which the work is completed with the minimum of manpower.

The following notes prepared by officers of the Public Works Department on some clearing operations undertaken towards the end of 1944 are published in the hope that readers will gain from them some idea of the capabilities of these machines and their average operating costs in different types of country.

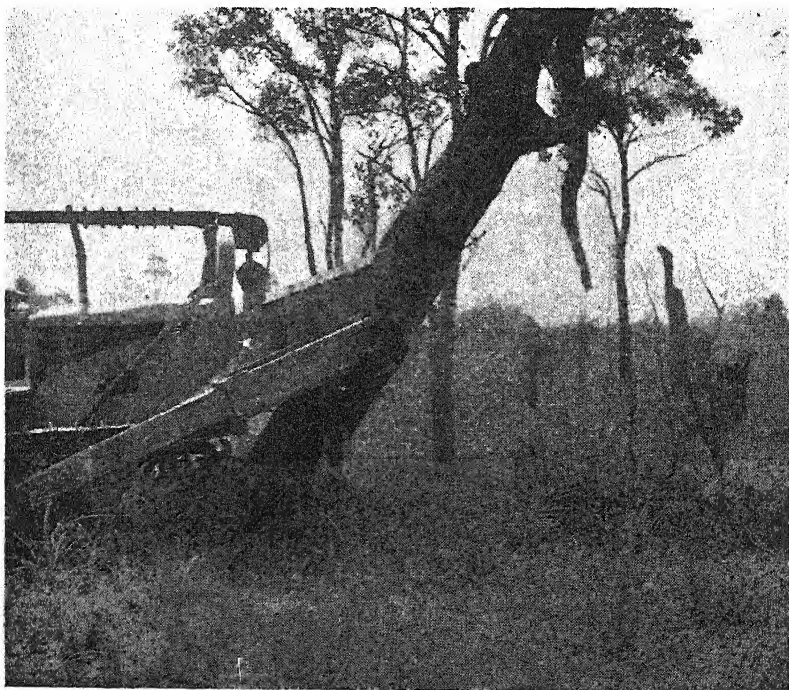
THE area cleared was 53 acres on Lot 53 adjacent to the Flax Mill at Beelerup.

The purpose of the clearing was to enable the flax authorities to leave ground on which to spread flax for dew retting, and for this purpose the trees knocked down by the bulldozer were later stacked by it so that a maximum area of cleared ground was left on which retting could be commenced immediately.

Both the surface and sub-soil were white sand and the land was timbered in two distinct zones which merged into each other where they met.

The lower sloping portion of the block was heavily timbered with banksia which thinned out towards the edge of the block. The only other vegetation on this zone was zamia palms and light brush with very little undergrowth. This zone merged into the upper flat portion which was typical light jarrah forest in which the merchantable timber had been cut out only recently, leaving the loppings spread about.

On the banksia zone, the entire vegetation, except for a few zamia palms, was able to be cleared, but in the jarrah zone the majority of the trees over 12 inches in diameter were too firmly rooted for the bulldozer to knock over. On a clay soil the bulldozer will knock over jarrah trees up to 18 inches in diameter.



A 'dozer in action.

If a push could be obtained higher up the tree than the 2ft. 6in. at present, the tractor would have sufficient power to push over much larger trees.* In this connection a bulldozer with an additional blade at a higher level is illustrated in "Pix," April 29th, 1944, issue, which, powered by an 80 h.p. tractor, can knock over trees up to 3 feet in diameter. The "treedozer," as it is termed, was made privately in Sydney.

If heavy clearing is to be done to any extent, a similar attachment would be of great value with the D.7 tractor and bulldozer.

In the banksia zone there was an average of 74 trees per acre, all being banksia which can be classified into the following diameters.

Size Diameter.	Under 6 in.	6 in. to 9 in.	9 in. to 12 in.	12 in. to 15 in.	15 in. to 18 in.	18 in. to 24 in.	24 in. to 30 in.
Banksia per acre	16	16	21	11	5	3	2

In the jarrah zone the average classification per acre was as follows:—

Diameter.	Under 6 in.	6 in. to 9 in.	9 in. to 12 in.	12 in. to 15 in.	15 in. to 36 in.
Jarrah	11	10	5	3	...
Banksia	5	6	3	4	...
Other	10	3	2	3	...
Blackboy	55	...	...	...	...
Jarrah left standing ...	...	...	...	3	12

The clearing consisted of two distinct operations, the first of which was to go over the area with the bulldozer and knock over everything it was able to, the second of which was to push everything knocked over into heaps or rows. It was not possible to combine these two operations as the timber was too large and unwieldy to rill off the blade when falling it.

(1) In this operation the tractor driver worked systematically up and down the area and knocked over all the trees and scrub he could. The area he covered per day varied very little in the different classes of timber and a daily average struck after he had worked a few days in the banksia area was maintained fairly closely over the whole block. The area fallen was 53 acres in 65 hours worked on seven days or 0.8 acres per hour.

(2) In the stacking operation the bulldozer was driven at right-angles to the direction in which the falling was done. The driver was able to carry the material 1½ to 2½ chains, thus making lanes 3 to 5 chains wide, depending on the density of the timber. In the jarrah areas the stacks were not in continuous rows, as was done in the banksia area, but were arranged around the standing timber to give the greatest clear ground area. The stacking operations took 131½ hours worked on 14 days or 0.4 acres per hour.

The tractor was driven from Boyup Brook to Beelerup under its own power on a gravel road. The rate of travel was approximately 2½ miles per hour. The time allocated against travelling was 23½ hours.

* A blade capable of rising 7 feet from ground level has since been fitted.—Ed.

Servicing.—The time spent on fuelling, oiling, greasing and checking over the machine was an average of $1\frac{1}{4}$ hours each day worked, with an additional total of 14 hours worked during week-ends, making a total of $40\frac{1}{2}$ hours.

The total time worked, including travelling from Boyup to Beelerup, and servicing, was $260\frac{1}{2}$ hours, of which—

185 hours was at single time,
44 hours at time and one-half,
 $31\frac{1}{2}$ hours at double time.

	£	s.	d.	£	s.	d.
<i>Costs:</i>						
Drivers' Wages (including pay roll tax and tent allowance)				50	16	7
Hire of bulldozer and tractor (1 month less 1 day)				83	6	8
Fuel and oil				52	13	1
<i>Sundry Costs:</i>						
Welding repair	0	7	6			
Fares and travelling allowance	6	5	0			
Cost of transporting material and visiting the clearing	7	16	8			
					14	9
Workers' Compensation					1	13
						7
Total cost				£202	19	1

Included in this cost is the following cost of moving the tractor from Boyup to Beelerup:—

<i>Wages:</i>	£	s.	d.
$21\frac{1}{2}$ hours @ single time; 2 hours @ $1\frac{1}{2}$ time— $24\frac{1}{2}$ hours			
@ £6 9s. 8d. week	3	12	3
50 gallons of distillate @ 1/9	4	7	6
Oil, say, £1	1	0	0
Hire $2\frac{1}{2}$ days @ £2 12s. 6d.	6	11	3
Transport of camp, etc.	4	2	0
	£19	13	0

Cost per acre:

	£	s.	d.
(a) Falling	1	5	6
(b) Stacking	2	11	1
Falling and Stacking	£3	16	7

HARVEY DISTRICT.

The object of clearing in this district was to open up additional potato land.

The D.7 Caterpillar Tractor with Bulldozer attachments was stationed in this area for four months during which time there were $82\frac{1}{2}$ working days or

650 effective working hours. Three hundred and seventy-eight acres were cleared. Farmers were anxious for a maximum area of trees knocked down, so that apart from one eight-acre plot, no time was spent in stacking.

Practically all trees knocked over were up-rooted. Little trouble was experienced with breaking off at ground level.

Time worked effectively.	Hours idle due to bogging.	Days idle due to breakages and repairs.	Hours spent travelling.		Hours spent servicing.
			Between properties.	To and from district.	
82½ days @ 650 hours	26 hours	23½ days	24	18	93

Gross working days in the district: 30/6/44 to 7/11/44, including days travelling to and from the district = 112 days.

Of the time idle due to breakages and repairs, 13 days were lost when the unit first arrived in the district due to breaking the sump. This necessitated parts being sent to Perth. Hire charges were waived for this period and other charges were not debited to the clearing authority.

Five days were lost due to broken winch housing—an exceptional delay due to bad organisation.

Three days were lost due to eight studs shearing off the track frame.

These major stops represent 21 of the total 23½ days idle due to breakages and repairs.

Acres Cleared.	Total Cost.	Cost. per Acre	Cost per effective day worked.	Cost per Hour.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.
378	807 10 5	2 2 6	9 16 0	1 4 10

The cost per acre varied considerably for different types of clearing, as can be seen from the following figures:—

	No. of Acres.	No. of Hours.	Cost.	Cost per Acre.
			£ s. d.	£ s. d.
State Farm	60	110	130 18 2	2 4 0
Dempster	90	186	223 0 6	2 10 0
B. Lofthouse	45	112	133 15 6	3 0 0
Barnes	75	87	103 15 8	1 8 0
S. Fry	60*	99	118 3 11	2 0 0
V. Abbott	5†	21	25 1 3	5 0 0
Gibbs Bros.	5	18	21 9 0	4 4 0
A. Barnes	38	43	51 6 5	1 7 0
Total	378	676	807 10 5	...

* Plus Road

† Plus Drain.

Property.	Labour.	Freight and other Charges.	Material.	Plant Hire.	Totals.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
State Farm	38 12 0	2 7 2	33 10 3	56 8 9	130 18 2
Dempster	66 8 3	4 14 4	56 12 10	95 5 1	223 0 6
B. Lofthouse	39 14 9	2 9 3	34 2 0	57 9 6	133 15 6
Barnes	30 17 0	1 16 8	26 9 0	44 13 0	103 15 8
S. Fry	35 2 6	2 2 5	30 2 6	50 16 6	118 3 11
V. Abbott	7 8 9	11 3	6 5 9	10 15 6	25 1 3
Gibbs Bros.	6 7 6	9 9	5 7 0	9 4 9	21 9 0
A. Barnes	15 5 5	15 7	13 4 1	22 1 4	51 6 5
Total	239 16 2	15 6 5	205 13 5	346 14 5	807 10 5

This analysis reveals the following approximate figures:—

Labour costs: £3 per day.

Material: £2 10s. per day.

Plant Hire: £4 per day.

STATE FARM—£2 4s. per acre.

Situated at Wokalup in the hills. Sixty acres in all were cleared, made up of two areas—42 acres and 18 acres.

The first and larger area was mostly a dense growth of blackboys averaging approximately 6ft. apart of 120 per sq. chain, varying in size from a few inches high to 2ft. Red gum saplings up to 6in. in diameter 10 per acre sparsely scattered over the area. Approximately 50 per cent. of the blackboys were missed due to the roughness and slope of the country. Rock outcrops were plentiful. Small blackboys with leaves only showing above the ground were not unearthed.

The second area of 18 acres was much more densely timbered. Twelve acres of red gum and jarrah saplings up to 6in. diameter averaged 10 per square chain. The remaining six acres supported a thicket of red gum and jarrah saplings with an intensity of 20 per sq. chain. Blackboys were numerous over the area. One large dead tree per acre, over 18in. in diameter, was knocked down. Hillside showed seepage patches.

DEMPSTER—£2 10s. per acre.

Fifty-three acres part heavy; 27 acres light, but difficult travelling.

Situated south-east of Wokalup on undulating hill country—90 acres were light white gum country up to 18in. diameter, interspersed with jarrah and red gum and a light scrub undergrowth. From 6in. to 18in. in diameter—15 per square chain. Blackboys were scattered throughout the area. Four acres were pasture paddocks with rung trees one per sq. chain up to 2ft. 6in. diameter. The remaining 27 acres was hilly and stony with irregular rock outcrops. Parts were very steep. The vegetation was a sparse scattering of suckers up to 9in. diameter. Very little scrub undergrowth. Occasional big trees up to 18in. diameter and big dead trees knocked over.

B. LOFTHOUSE—£3 per acre.

Small timber, but thick. This area was good potato land. Forty-five acres in area. Situated in the hill country south-east of Wokalup. Fifteen acres were evenly timbered gently sloping hillside with jarrah and red gum saplings

up to 9in. diameter, mostly under 6in. diameter, averaging 20 per sq. chain. There were no big green trees but odd dead trees were knocked over. Blackboys occurred in dense patches and were mostly removed.

The remaining 30 acres showed a variety of timbering. Eight acres was a white gum flat with trees up to 9in. diameter.

Seven acres of lightly timbered jarrah and red gum re-growth with practically no undergrowth.

Fifteen acres on the sloping sides of a watercourse were heavily timbered with red gum with a sprinkling of jarrah 9in. to 12in. in diameter—a light scrub undergrowth.

BARNES—£1 8s. per acre.

Dense sapling country. This property situated on the foothills and extending into the hills south-east of Wokalup, comprises 75 acres. The surface was stony with no sign of seepage patches.

Fifteen acres formed pasture paddocks with a re-growth of red gum saplings up to 9in. diameter. This was on gently sloping ground. Timber intensity was 50 saplings per sq. chain. The remaining 60 acres on steeper hillside consisted of young red gums up to 6in. diameter, 30 per sq. chain, and young blackboys up to 6in. in height, 100 per sq. chain—50 per cent. of these were unearthed. Those showing leaves only above the ground were untouched.

Occasional dead trees up to 30in. diameter were knocked down.

Six chains of roadway were formed to provide access to the new clearing.

Trees on an 8-acre area on the thicker timbered hillside were stacked in rows.

S. FRY—£2 per acre.

Twenty acres very light, 29 acres much dead timber. Difficult country. Eleven acres partly heavy saplings.

This property was in the hill country east of Wokalup. Clearing was done over an area of 60 acres.

Twenty acres comprised pasture paddocks at the foot of the hills and work here entailed knocking over dead trees averaging 2ft. diameter occurring approximately two per acre.

Twenty-nine acres on steeply sloping country in the hills was cleared of dead trees. These occurred thickly over the area, five per sq. chain, from 6in. to 12in. in diameter, with bigger trees up to 2ft. diameter less frequently. No green timber was touched.

The remaining 11 acres was mostly green timber—jarrah and red gum re-growth occurring 20 per sq. chain, from 4in. to 9in. in diameter. Occasional dead trees were knocked over. Blackboys were on the area but not in dense patches. Those of any size were removed.

Ten chains of access road were formed through a rough steeply sloping ridge.

V. ABBOTT—£5 per acre.

This area of five acres was on the plains south-west of Wokalup. The soil was sandy. The tree growth was a dense re-growth of jarrah and red gum saplings up to 9in. in diameter, 15 per sq. chain with three per sq. chain up to 12in. diameter. Large dead trees from 2ft. to 4ft. in diameter occurring one per sq. chain, were knocked over, but large green trees up to 4ft. diameter were left.

A number of the saplings grew from old tree stumps and in most cases these could not be removed. This factor, combined with the poor traction in the sandy soil, made progress slow.

One acre of dense ti-tree and paperbark swamp was cleared and a drain approximately five chains long was formed through the clearing. This drain was 12ft. wide and a foot to 18in. deep.

GIBBS BROS.—£4 4s. per acre.

Situated two miles east of Harvey in the hills. A total area of five acres was cleared. The vegetation was dense peppermint with scattered red gum saplings 10 per square chain. Large dead red gums, eight per acre up to 3ft. diameter, were knocked down. There was a bracken and heavy grass mat undergrowth. A creek runs through the area but peppermints immediately lining the water were not touched. The clearing was done on gently sloping hillside. Good loam for potato growing.

A. BARNES—£1 7s. per acre.

Situated six miles east of Harvey in the hills. A total of 38 acres was cleared on this property. Thirty-two acres was of jarrah and red gum with occasional wandoo. Ten saplings up to 6in. diameter per sq. chain, four from 6in. to 15in. diameter per sq. chain, one over 15in. diameter per sq. chain, was left as it was considered uneconomical to spend time on these odd trees.

Dead trees up to 2ft. diameter occurring two per acre were knocked over. The work was on gently sloping laterite hills—good potato land. The other six acres was more densely timbered. Twelve trees from 6in. to 15in. per sq. chain. Trees over 15in. diameter, four per sq. chain, were not touched. Three hours was spent on firebreaks on this property.

Flock Establishment and Improvement.

By

W. L. McGARRY, Sheep and Wool Adviser.

IT is generally agreed that the present high prices ruling for Merino wool will not last indefinitely. In view of this and while prices are very profitable, an admirable opportunity exists for growers to take steps leading to flock improvement. Improved returns per head from better sheep will enable woolgrowers to better withstand the inevitable decline in wool prices.

Production Costs.

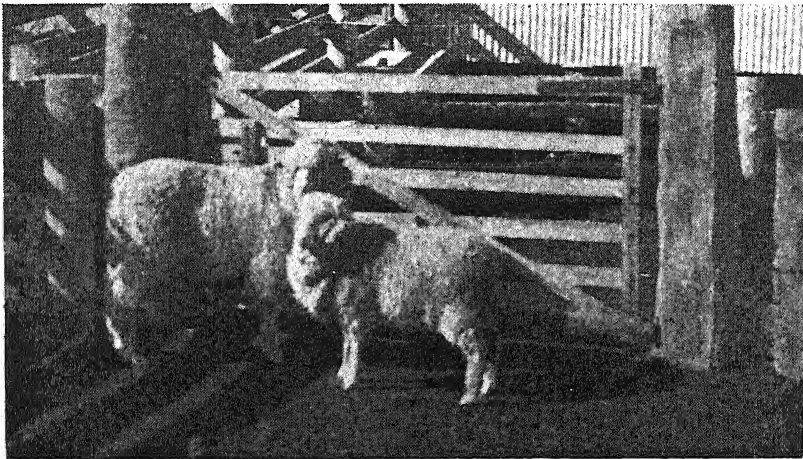
Production costs are of paramount importance in wool production particularly when lower prices rule and in the main the most feasible way in which the grower can reduce his production costs is by increasing the *quantity* and *quality* of wool cut per head of sheep—or in other words by increasing the monetary returns per head of sheep run. Producing cheaper wool means producing more and better wool per sheep.

Quantity and Quality.

The aim in woolgrowing should be to produce as great a quantity of good quality wool per sheep as possible. Quality is emphasised because in Merino wool a premium is paid for quality and for this reason the desirability of retaining quality is very important and should not be overlooked when striving for quantity.

Feeding.

The amount of wool cut per sheep is governed by two factors. They are nutrition (or feed) and breeding (or inheritance). Of the two there is no doubt that nutrition plays the biggest part in the amount of wool cut per sheep. Unless a sheep is on a good level of nutrition from the time it is born it is unable to produce the maximum amount of wool of which it is genetically capable—or in other words it is unable to fully express in wool production its inheritance for this factor. Good nutrition results in the development of more wool producing follicles during the growth of the sheep, which in turn leads to greater wool density or in other words more fibres per square inch of skin on the sheep. Good nutrition will also make a bigger sheep with a larger skin area on which to grow wool. The more wool bearing skin on a sheep the better (up to a point) as it has been found that about 90 per cent. of the skin area on a sheep is bare. Thicker and longer wool fibres are grown by the sheep when the nutritional conditions are good and if the millions of fibres that go to make up a fleece are thick and long instead of thin and short then the fleece must be heavier, provided of course, the wool density is about the same.

*Effects of Nutrition.*

Two ewes—same age—same sire. Left: well nourished, body weight 119 lbs.
Right: poorly nourished, body weight 54 lbs.

Breeding.

It is often remarked that the term "quality" in Merino wool is rather a vague term and it appears desirable to define "quality"—that is thinking in terms of "good quality" wool and not referring to the count or fibre thickness.

A quality wool can be described as a wool possessing to a high degree all those characteristics which wool buyers and wool manufacturers desire and pay high premiums for.

These characteristics are:—

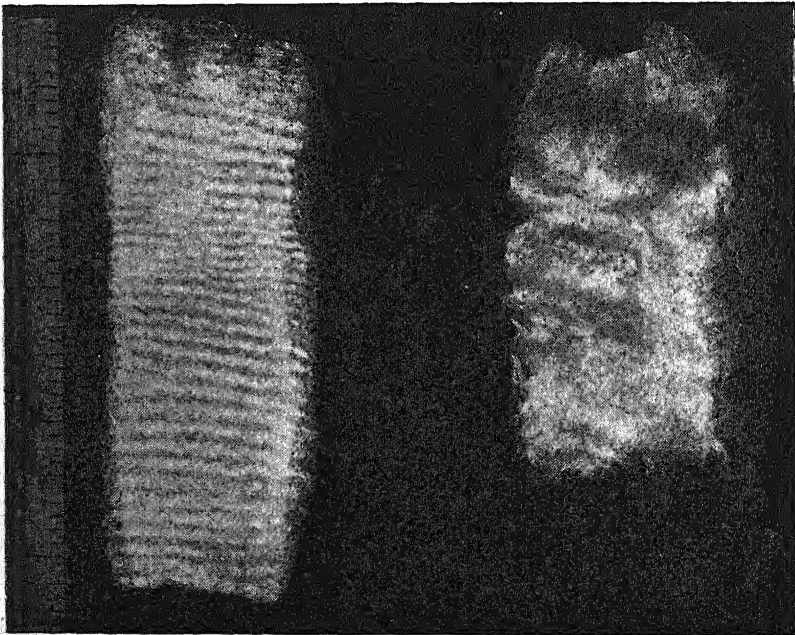
- (1) Good staple length.
- (2) Correct staple length for fibre thickness.
- (3) Soundness throughout the whole staple length.
- (4) Robust or thick staple.
- (5) Pronounced, regular and even crimp.
- (6) Good square tip free from hairyness and fluffiness.
- (7) Free and even fibre growth throughout the staple.
- (8) Density.
- (9) Softness.
- (10) Elasticity.
- (11) Colour.

Although nutrition (feed) plays a part in some of these characteristics the main role of nutrition is to produce *quantity* and reliance must be placed more on *breeding* rather than *feeding* if we are to establish and retain quality in our wool.

In woolgrowing feeding and breeding must go together to get the optimum returns. Breeding without feeding is senseless and feeding without breeding is only going half way because a sheep of poor type costs as much to feed and care for as a good one and a good type will convert feed into wool and meat much more profitably than a poor type.

Sheep Type.

When establishing a Merino flock it is advisable to give careful thought in deciding the type which will be most suitable for the conditions under which the sheep are to be run.



Strong Wool Type.

Left: Good quality. Right: Poor quality

Our agricultural areas are suitable for the production of both medium and strong wool and in the pasture or better feed areas it is advisable to remember the important influence of good nutrition and climate on fibre thickness (count) when deciding on wool type because the production of over strong and "doggy" wool is undesirable and unprofitable.

Generally the quality within the type is more important than the type itself, i.e., a good medium wool flock is better than a poor strong wool flock and vice versa.

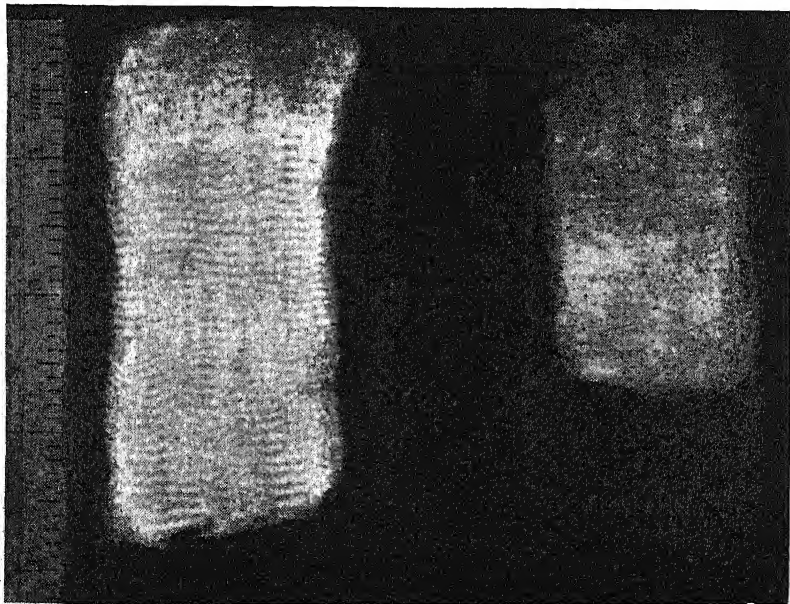
Foundation Ewes.

It is advisable to purchase these from a reputable breeder known to have good sheep. The choice generally lies between young ewes (which are usually sold for some fault) or cast for age ewes. It is generally agreed that the C.F.A. ewes will make the safer foundation stock. Proof of their merit lies in the fact that they have been kept in the flock a number of years and would be superior to the average of the breeding flock.

They would also, with proper treatment, give a better lambing percentage than the young ewes.

It must not be forgotten, however, that their fleeces will be light and that their progeny, in the main, will not be as good as themselves and will tend to revert down to the average of the flock from which the mothers came.

The young ewes (assuming they have faults but are not outright culls) will have a longer wool producing life in front of them, and though somewhat inferior themselves would have progeny which would tend to revert up to the average of the young ewes kept because of merit and as a result would produce many useful sheep.



Medium Wool Type.
Left: Good quality. Right: Poor quality.

purchase of foundation ewes it is a definite advantage to inspect the flock beforehand if possible and also ascertain when they will be available for inspection will reveal their wool type and cutting possibilities which will be of great value.

Classing of maiden ewes just prior to shearing is a necessary management. The main benefit of an annual culling is an increase in the number of ewes. It is advisable to cull with a view to higher immediate results. A wise selection of rams for the future improvement of the flock. The sheep to be culled will be those showing serious defects; poor constitutioned and off type sheep and those lacking in wool quantity and quality. Serious defects are obvious at a glance and would include slab-sides, bad hocks and feet, badly undershot or overshot jaws, woolly faces, etc.

An elevated classing race is an advantage but in practice the average farmer's flock can be classed quite satisfactorily in the drafting and branding races. If the sheep are put through the drafting race first the obvious culls can be taken out with a minimum of labour as they come down the race. It will be necessary to inspect the remainder closely in the branding or classing race where the movement of the sheep is restricted.

When the classing is completed the flock should be drafted into three yards—outright culls, culls, and keepers. It is then advisable to walk slowly among the sheep and rectify any mistakes made. Always ear mark the culls on the spot before they leave the yard with the prescribed cull mark, i.e., a punch hole in the opposite ear to that bearing the registered ear mark.

It is a waste of time and money to cull a flock and not dispose of the culls.

Selection of Rams.

The ram plays a much bigger part in the improvement of the flock than the ewe and for this reason careful selection is necessary when purchasing sires. Always avoid cheap and inferior sires.

Whenever possible it is advisable for growers to select their own rams, because they, by virtue of their close association with the flock, should be best qualified to select suitable rams. If in doubt growers should seek the opinion of those who are experienced and qualified to advise and who have had the opportunity of inspecting the flock.

Rams should not be selected for fancy points of imagined importance to the exclusion of commercial characteristics which should be the main consideration. It is obvious that something must be "given away" in rams of the 10-20 guinea grade, and it is important not to give away valuable commercial characteristics for points of secondary importance.

Rams should be selected with a view to producing good constitutioned, compact sheep possessing warp (good length) wool of good quality which will process into good weights of scoured product.

Research work has shown that the extensive use of progeny tested sires would result in spectacular flock improvement in a very short time. However, owing to many difficulties, indications are that it will be some time before commercial growers can purchase progeny tested rams or even rams sired by progeny tested rams in numbers. The selection of rams at present is still on a basis of phenotype, i.e., appearance, and in view of this the following principles will prove useful as a guide when selecting:—

1. It is advisable to select rams from those studs where the standard of the sheep in the stud is uniformly high and even. Flock improvement will be more certain if rams are secured from studs of this type than where sires are secured from studs which have a few outstanding sheep, but where the average quality of the sheep is not high and even.
2. Select from those studs whose rams by experience retain or improve their quality under the conditions where they are used.
3. Keep to the one blood, and if possible, to the one breeder.
4. Select rams with the type of wool most suited to the country where they are to breed.
5. Rams should be somewhat stronger (not over strong) in the wool than the flock count (fibre thickness) which is desired. Definite and even crimp in the fleece, a thick upright staple of good length and good tip are desirable.
6. Soundness in feet, mouth, reproductive organs, constitution and freedom from defects generally transmitted are main considerations. Do not be carried away by "pretty" wool to the exclusion of essentials.

A beneficial breeding practice, particularly in medium wool flocks, is to grade the breeders and rams as soon as they are shorn according to their development and mark or brand them accordingly. The development is masked to a certain extent when the sheep are in the wool, but can be readily seen off shears.

This grading can be done practically all through the drafting race and most flocks would average about half each of the two types, i.e., "plain" and "developed" to varying degrees. If this is done, then at mating join the more developed rams with the plainer bodied ewes and the more developed ewes with the plainer bodied rams. This procedure will tend to improve the confirmation and cut per head of the progeny and lead to greater uniformity.

ERRATA.

VOL. XXIV., No. 1, MARCH, 1947.

Page 33, foot of Table III:—To "W.A. = Water absorption" add "on a 13.5 per cent. moisture basis."

Page 34, section 3, second paragraph, line 5:—For "top of the grain falls below the level of the mid-point of the graph" read "top of the graph falls below the level of the mid-point of the graph."

Page 36, Table IV, under heading "Variety and Source":—In each instance after "Specific Protein strength from" insert "(a)" before "strength figure" and "(b)" before "Pelshenke time."

Paragraph one, line six:—For "either figure or the Pelshenke time" insert "either strength figure or Pelshenke time."

Page 69, paragraph two:—Delete "MERREDIN, Mr. E. R. Watson, B.Sc., (Agric.)."

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Rearing of Chickens.

E. LOVEGROVE, Chief Poultry Adviser, and
S. FROOME, Poultry Inspector.

INTRODUCTION.

THE heavy mortality occurring in the rearing period of the domestic fowl is becoming more evident year by year. This percentage of deaths is so high that, did it occur in other stock, an immediate drive, by all interested, would be made to stop this excessive wastage. The successful rearing of strong, healthy birds is the salient factor governing profit or loss on the poultry farm.

Present day needs make it necessary to produce chickens in large numbers, but modern intensive methods and mass production require a high standard of knowledge and skill in the operator. Even with the specialised knowledge the rate of mortality will still be high if the parent stock are not possessed of a strong vigorous constitution capable of resisting disease. To get real progress in chicken rearing the poultry industry will have to support pedigree breeding establishments; where, by genetic breeding, resistance to disease can be established, and where all breeding stock would be tested for such diseases as Pullorum until no positive reactors can be found.

Few pedigree breeding farms have been a financial success because this type of breeding is expensive, but poultry farmers will be forced to support these to decrease the mortality in their flocks, and in the rearing of their chickens.

A State Breeding and Experimental Station coupled with a Poultry Improvement Plan as in operation in the United States of America would go far in the solution of the high mortality problem. The objectives of this Plan are well worth consideration and are outlined as follows—

- (1) To improve the production and breeding qualities of poultry.
- (2) To reduce the mortality of chicks from Pullorum disease.
- (3) To identify authoritatively, breeding stock, hatching eggs and chicks with respect to quality, by describing them in terms uniformly accepted.
- (4) To serve as a means through which scientific research may be applied for the improvement of poultry and poultry products.

A plan such as this would be of immense value in improving the average quality of poultry throughout the country, would check the increasing mortality in chickens and place the industry on a firmer financial base.

GENERAL.

The foundations of a successful poultry farm are the breeding stock, and the treatment the chickens receive during their development to maturity. These two salient factors are linked together because a flock of well grown, disease resistant birds must be raised annually as future breeders and be capable of withstanding the strain of continuous egg production.

When chickens are produced on the farm it is essential to breed only from Pullorum tested stock of a high egg producing and disease resistant strain. Special attention should be given to the selection of the males which should be progeny tested. The above qualifications may not be easy to obtain but they are necessary fundamentals to successful poultry farming.

Today, it is common practice to purchase day-old chickens from a hatchery or from a well established poultry farmer. It is estimated that 75 per cent. of the chickens raised in Western Australia are purchased from these sources. It is to be expected that chicks can be produced more cheaply on a large scale than on a small scale.

If it is necessary for the poultry farmer who breeds from his own flock to consider the factors previously mentioned, it is equally necessary for the purchaser of day-old chickens to obtain all the information possible before he places his order with a hatchery. However good the chicken rearing management may be, it is obvious that satisfactory pullets cannot be reared from chicks of poor breeding stock. Chickens should be purchased only from breeders or hatcheries with a reputation for sending out healthy, disease resistant stock. Chickens of inferior quality which may be offered at a low price are not worth purchasing and are a menace to other birds.

Those breeders and hatcheries who have built up a reputation for good stock are usually inundated with orders and to procure chickens at the right time they should be ordered many months previously. In some cases orders, especially repeat orders, are booked 12 months ahead.

Time of Hatching or Purchasing.

The hatching season is a limited one; neither very early hatched nor late hatched stock are desirable. Chicks hatched at the correct time usually grow better and suffer less mortality than those hatched at other dates, and should be in egg production in the autumn and winter which is the period of high egg prices. For their early hatched chicks hatcheries have to rely to a great extent on pullet eggs which do not produce the large, healthy, vigorous chick which is essential if the percentage of mortality is to be kept low during their lifetime.

Late hatched chicks are usually slow in maturing and do not come into production until probably as late as June or July when the fall of egg prices occurs.

In the vicinity of Perth the most successful rearing is obtained by hatching from mid July to the end of August for heavy breeds and from 1st August to the middle of September for light breeds. This statement should be used only as a guide and local conditions should decide the hatching or purchasing date.

The area declared by the Controller of Egg Supplies can be considered as the egg producing districts of Western Australia. It commences some miles north of Geraldton, includes Merredin on the Eastern Goldfields Railway, and then follows No. 1 Rabbit Proof Fence to the coast east of Hopetoun. It is obvious that climatic conditions must vary considerably over this large area. In the extreme northern and eastern portions, where summer conditions are experienced early, it is advisable to commence the chicken rearing season a month earlier than the time previously stated. Conversely, in the extreme south-west portion of the State, approximately south of a line drawn from Bunbury to Albany, the best results are obtained when chickens are hatched a month later than the Perth dates.

It cannot be too strongly emphasised that the date of hatching is an important factor in future egg production. Pullets hatched too early may come into production in December or January and after a few weeks laying may go into a moult, at the same time as the hens, and not come into production again until the end of June or July.

The Importance of Sanitation and Fresh Air.

As the maintenance of a high degree of sanitation and the provision of a constant supply of fresh air are two important factors during the growing period of the chick, it is necessary to comment in a general manner although details will be noticed throughout this article. Unsanitary environmental conditions have an adverse effect on young stock by giving optimum conditions for the increase of disease bacteria, and by rendering the chicks more susceptible by lowering their resistance to disease. The term "sanitation" is used in its widest form and embraces not only cleanliness, but overcrowding, ventilation, uncontaminated soil, and freedom from internal and external parasites.

The periodical removal of the excreta is not sufficient to maintain the standard of cleanliness required but everything with which the chicks or developing stock come into contact must be kept in a sanitary condition. Cleaning is best done by removing any excreta or dirty litter and then scrubbing with caustic soda solution followed by a liberal spraying with a 5 per cent. coal-tar disinfectant.

Food and water should be provided in the most sanitary conditions possible. Contamination of food and water can be largely avoided; hoppers and drinking vessels can be so constructed that the chickens and growing stock can be prevented from getting into the food and water. In badly constructed hoppers the food falls on the floor, becomes filthy and causes digestive disorders and disease. Covered drinking vessels can be used to keep out droppings and dirt.

Overcrowding is the source of many troubles throughout the life of the domestic fowl. Research work carried out by the Delaware Extension Service shows that overcrowding increases the percentage of deaths, retards the rate of development, decreases the average weight per bird, and increases the amount of food consumed per unit of weight gained. Crowding accentuates the problems of moisture control and ventilation; wet floors or moist patches on the floors are common, and ammonia vapour lowers the resistance to disease and assists the spread of colds and coccidiosis.

When chickens are reared in a floor type of brooder it is generally considered that $\frac{1}{2}$ sq. ft. per chick is sufficient floor space for the first six weeks. For example a section of a brooder house measuring 5 ft. x 12 ft. will accommodate 100 chicks until they are six weeks old. A plentiful supply of fresh air is required by the chick even in its embryonic stage in the egg and after it leaves the shell this need for fresh air increases as the chicken develops.

Lack of proper ventilation in the brooder house results in stuffy, unhealthy brooders and damp litter and chicks reared under these conditions are more susceptible to colds, feather badly, and consequently feel cold quickly and suffer high mortality. The brooder house should not be draughty, but should be efficiently ventilated to dilute and remove carbon dioxide and moisture given off by the lungs, and remove carbon monoxide resulting from burning by lamps or brooder stoves. The brooder house must have fresh air during cold weather and at night, and the brooder should be warm enough to allow the passage of fresh air at any time. Provided there is ample heat under the brooder, chickens will grow better in a cool brooder house than in a warm one. Chicks are also warmed by internal heat generated by the combustion of the food they eat, and for this process they need oxygen which they can obtain from the air. Chicks in a stuffy brooder will always huddle because the natural process of heat production is being retarded by an insufficient supply of oxygen. The need for efficient ventilation is noticeable throughout the life of the bird; a poorly ventilated laying shed exhibits ideal conditions for the spread of colds in maturing pullets, with a consequent lowering of egg production in the early part of the laying season.

One of the causes of slow growth of young stock is the continued use of contaminated ground. This aspect of sanitation has been neglected in the past but poultry farmers are becoming aware that clean ground is essential during the early stages of rearing. As it is not practicable to attempt disinfection of ground, it is essential to prevent contamination as far as possible. Fresh ground each year is preferable, but is not always possible. However, the rearing area can and should be reserved for that purpose only, and during the time it is not in use can be sweetened by cultivation and by growing a green crop. Once land becomes contaminated with intestinal parasites, pullorum disease, or coccidiosis it is practically impossible to rear healthy chickens, and that area should not be used for the purpose for two years. The area selected as the rearing ground should be well drained so that no small pools of stagnant water collect on the surface, and it should be well away from the laying flock as old birds are a common source of infection.

Brooder House and Brooders.

It is beyond the scope of this article to describe in detail the various buildings suitable for brooding chickens, but the kind of house used should be one that is adapted to the type of brooder employed. The principles essential in all brooder houses are the same and include good ventilation without draughts, sufficient light with the admission of direct sunlight, possess a dry floor capable of being easily kept in a sanitary condition and free from vermin, adequate floor space, give protection and warmth, and be a well constructed durable building.

Owing to the shortage and high cost of building materials it has been a common practice in Western Australia, in recent years, to brood chickens in a laying shed instead of in a special brooder house. Under the circumstances it can be considered that this practice has been reasonably successful, but it should be regarded as only a makeshift and a brooder house should be constructed when conditions permit. If a shed which has previously housed poultry is to be adapted for use as a brooder house special sanitary precautions should be taken some weeks before the chickens arrive. Spray the woodwork with the creosote mixture suggested for the eradication of tick and red mite and spray the entire shed with a good disinfectant. Thoroughly clean up the area

surrounding the shed and cultivate the ground in the yards and plant a green crop. A laying shed can be divided by temporary divisions to accommodate three or four brooders.

There are many different systems of brooding in use and a varied assortment of brooders from which to make a choice, the majority of which will give satisfactory results if properly operated. Where electricity is available for brooder heating it is almost ideal because of the ease of operation and the simplicity of control, but it has one definite disadvantage, that is, the complete loss of heat during a breakdown of the power. Many types of electric brooders are now manufactured with an auxiliary kerosene lamp heater which can be used when necessary.

The back-yard poultry keeper with his dozen hens usually gets better egg production per hen than the commercial poultry farmer with his flock of 2,000 birds; in the same manner, small to moderately sized groups of chicks give better results than large groups, but the group cannot be too small because the cost of housing, equipment and labour would be uneconomical. It would appear that groups of 100 chickens are most satisfactory, but nevertheless, good results are obtained from groups of approximately 250 under colony brooders. The rapid expansion of the industry, and the larger farms now operating, have encouraged the use of large battery brooders, but they are divided in such a manner that the 100 group is retained.

When purchasing equipment, it should be remembered, that the chick capacity of a brooder is usually rated high by the manufacturer and allowances should be made accordingly. The capacity of a brooder is the number of birds it will brood towards the end of the period it is intended to keep the chicks under that particular brooder. For example, a brooder reputed to carry 200 chicks may give ample room when the chicks are day-old, but the chickens grow very fast, and at a fortnight old they would become overcrowded and each day would increase the congestion.

The number of chickens it is intended to rear during the season will, to a great extent, determine the type of brooder to be used.

Small Single Units.

If poultry rearing is a sideline and not more than 200 chicks are required, it would be advisable to use the single 100 chick brooder, which can be either an electric or kerosene lamp heated type, or a combination of both. Fig. 1 shows one of the many makes of the lamp heated brooder which are commonly used.

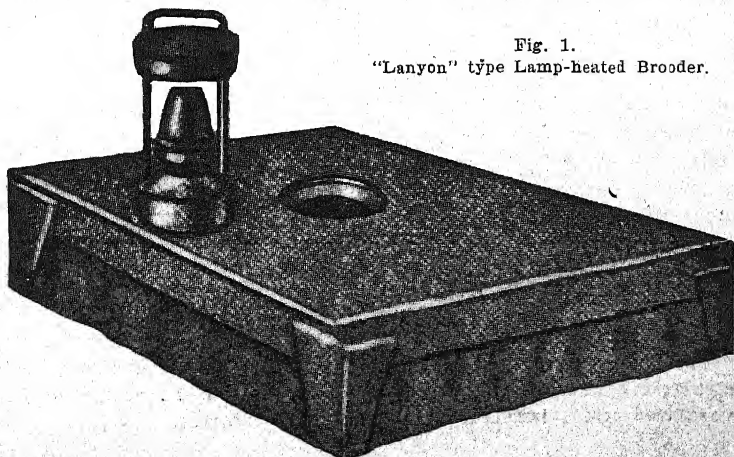


Fig. 1.
"Lanyon" type Lamp-heated Brooder.

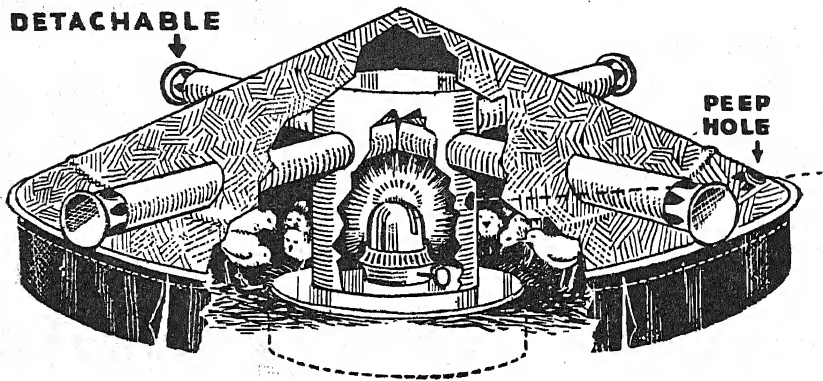


Fig. 2.

"Westworth" Lamp-heated Brooder. Manufactured in Western Australia.

Fig. 2 illustrates another type of kerosene brooder which gives good results when operated correctly. This brooder is manufactured under patent in Western Australia and is becoming popular. Fig. 3 is an electric brooder, but should the power fail the auxiliary kerosene burning heater can be used. This is primarily an electric brooder and on medium heat consumes 1 unit of current in approximately $6\frac{1}{2}$ hours.

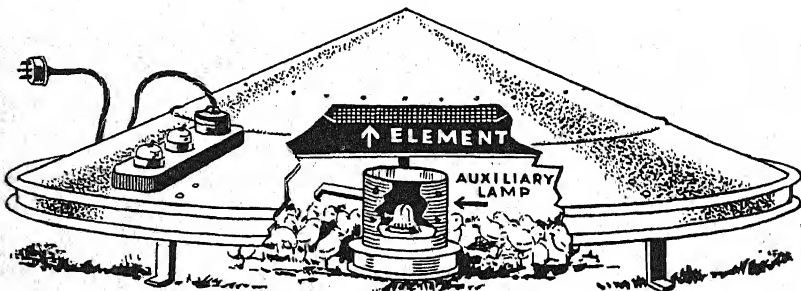


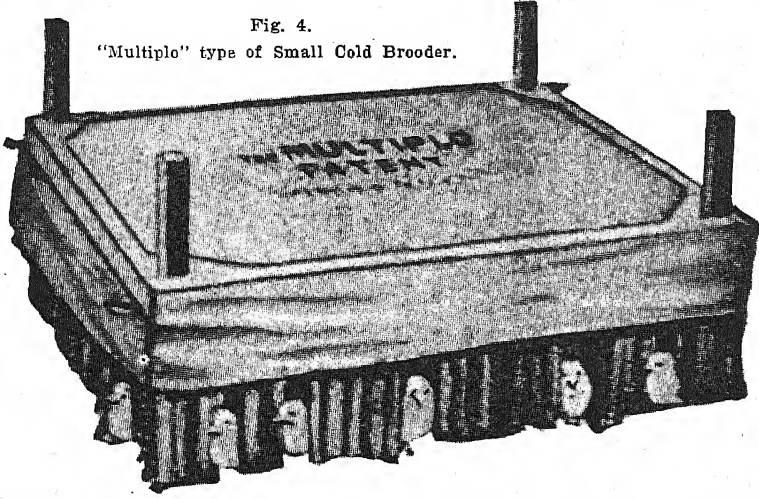
Fig. 3.

Electric Brooder with Auxiliary Kerosene Heater.

In the past there have been many methods of heating by electricity; some brooders depended on heat from one or more filament lamps, others were fitted with a long tubular lamp but these methods have been superseded by the use of "resistance wire" units. The heating unit is fixed near the apex of a conical metal brooder or in the top of the flat type of hover. Seventy feet of No. 8 or 120 feet of No. 16 ni-chrome (nickel-chromed) wire will give a temperature of 92°F . under a normally constructed 100 chick brooder.

As previously stated the three types of brooders illustrated are each a single unit capable of brooding 100 chicks, but if a larger chick capacity is desired two or more could be installed, but if several are used it increases the amount of labour required and a larger type of brooder is indicated.

Fig. 4.
"Multiple" type of Small Cold Brooder.



When brooder capacity is limited and the heated brooder is required for another batch of chickens it is common practice to transfer the chicks to a cold brooder when they are about 3 weeks old. Details of the change will be dealt with later under the heading of management but Fig. 4 shows a type of small cold brooder which can be used in conjunction with the 100 chick heated brooders described previously.

Colony Brooders.

Where it is necessary to rear a large number of chickens during the season a different type of brooder must be used. Two systems have given good results in the past, but where electricity is available they have been superseded, to some extent, by the battery brooders. However, the first of these, the colony brooder, has proved satisfactory in operation. It consists of a circular metal canopy with the lower edge, supported on iron legs, approximately 4 inches above the floor. The diameter at the bottom edge is 4 to 5 ft. and the heating unit is in the centre. Necessary ventilation is provided at the top of the hover, except in the case of the sawdust brooder.

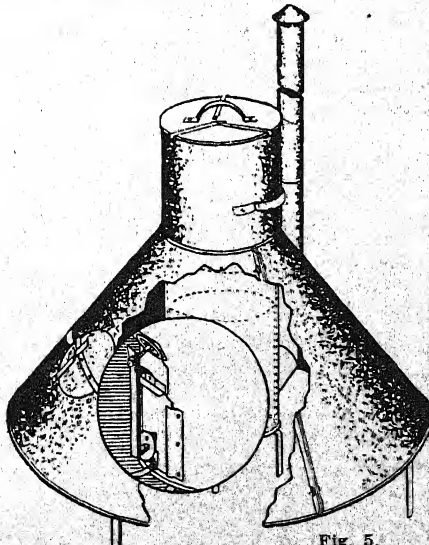


Fig. 5.

Fig. 5 is an automatic sawdust burning colony brooder which has capsule controlled heat. One filling of saw dust burns 12 to 18 hours and the most satisfactory results are obtained with batches of about 350 chickens. At the Parafield Poultry Station, South Australia, most satisfactory results have been obtained for some years with a colony brooder using a "Puritan" burner. Fig. 6 shows the colony brooder in use at Parafield and is as illustrated in Bulletin 365 of the Department of Agriculture of South Australia.

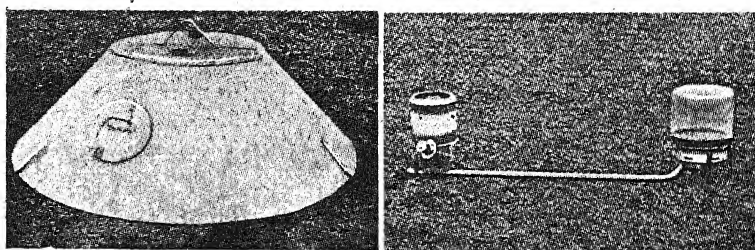
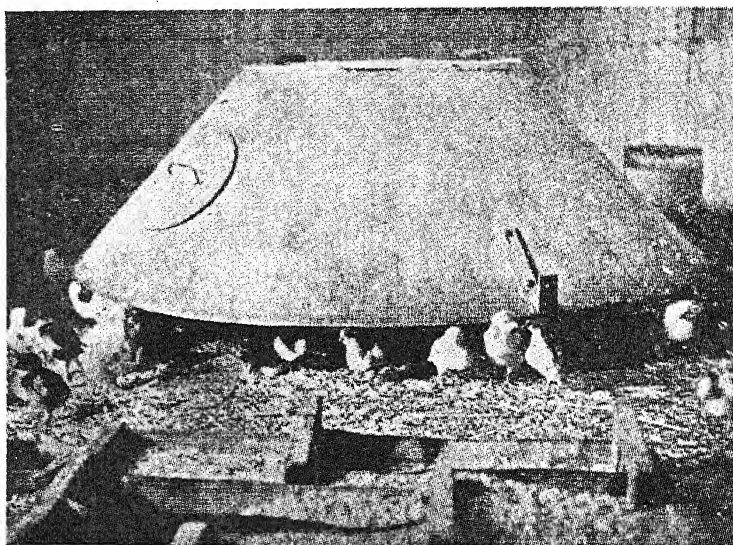


Fig. 6.
Kerosene-burning type of Colony Brooder.

Hot Water Brooding.

Hot water systems of brooding have been common for some years on large commercial farms. A hot water boiler is placed in one end of a long brooder house, and a pipe system runs the length of the house. The floor of the house is divided into sections each capable of carrying 100 chickens. In each section the pipes are covered by a canopy or brooder to preserve and throw down heat on the chickens. To maintain the required temperature in the long pipe system it is necessary to give constant attention to the boiler, including stoking during the night, which makes this system of chick brooding rather laborious. Should this system be installed care must be taken to ensure that the boiler is large enough to supply a reserve of heat to cope with low atmospheric temperatures.

Battery Brooders.

Not many years ago the first battery brooder made its appearance, and in spite of considerable criticism has become popular. This is no doubt due to the fact that its use has reduced to a minimum the labour, care and attention required by the chick for the first three weeks of its life. Experimental and practical work with this type of brooder has demonstrated that best results are obtained when the chicks are held for three weeks in the battery brooder and then transferred to cold brooders. The usual type of battery brooder consists of four tiers, each tier capable of holding 100 chicks, and each having separate heating. In some brooders the temperature of each tier is controlled separately, while in other designs a master control operates all sections and the temperature in the individual compartments is varied by control of the ventilators. The heating unit is usually an electric one but in districts where electricity is not available the battery brooder works quite satisfactorily with a kerosene lamp as the source of heat. Some makes of electric battery brooders are equipped with auxiliary kerosene heating as a safeguard in the event of a breakdown in the current.

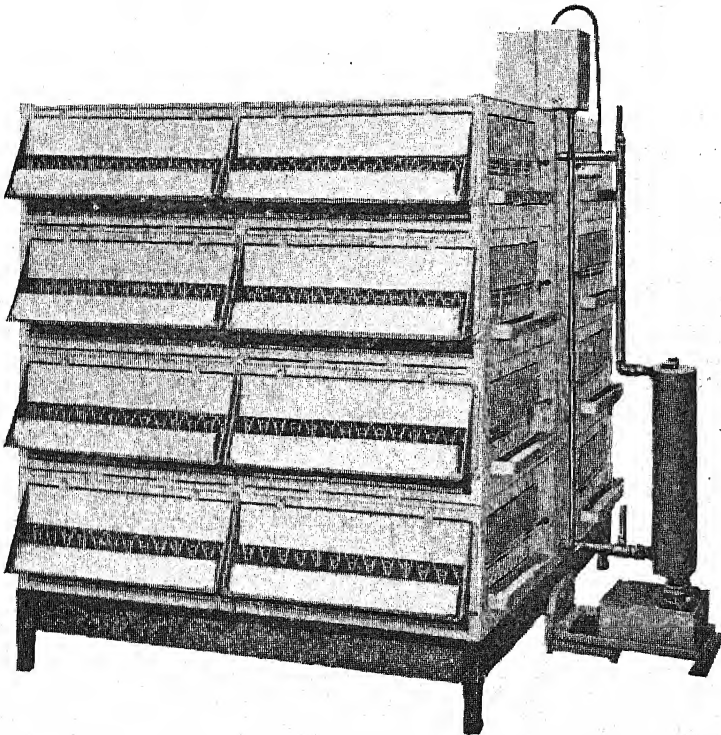


Fig. 7.

"Gloucester" type of Oil-burning Battery Brooder.

Fig. 7 is an illustration of a "Gloucester" battery brooder of the oil burning type and is capable of holding 1,000 chicks. Ample room for feeding is given by the troughs attached to the sides and water is correspondingly catered for.

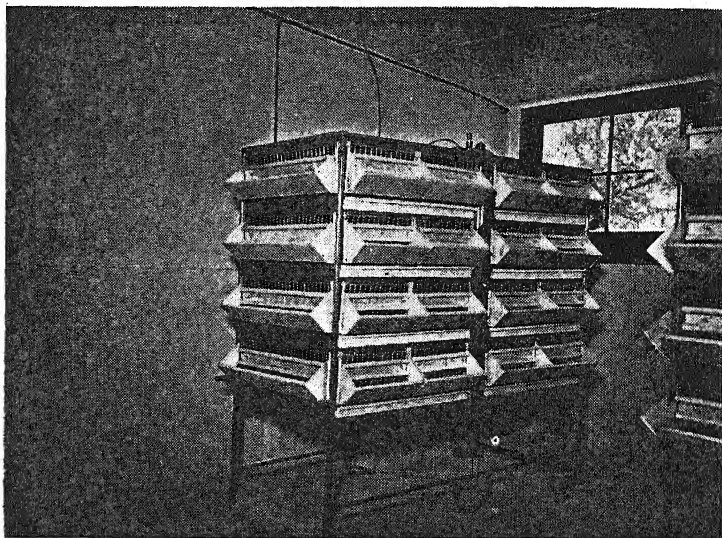


Fig. 8.

Electric Battery Brooder, with Auxiliary Kerosene Heater, 400 chick capacity.
On Mr. M. Stocker's Poultry Farm, Roleystone.

Fig. 8 shows a corner of the brooder room on Mr. M. Stocker's "Cavvy-stock Poultry Farm" at Roleystone. The brooders are 400 chicken capacity electric battery brooders which are fitted with the kerosene lamp auxiliary equipment. The brooder is 6 ft. long, 2 ft. 6 in. wide, and 5 ft. high and the floors are constructed of $\frac{1}{2}$ in. square mesh netting which enable the chickens to be kept under very sanitary conditions, as the droppings are collected on and can be cleared from trays beneath the wire floors.

A summary of the salient points of battery type brooders shows their economy of labour, sanitary rearing conditions, and the small percentage of mortality, good body size and feather growth of the chickens for the three weeks they are kept in the battery.

Cold Brooders.

After three weeks in a heated brooder chickens can be transferred to a cold brooder. Fig. 4, as previously mentioned, illustrates a type of cold brooder which is quite successful for small numbers of chickens but which entail too much labour if large numbers of chickens were to be reared. Fig. 9 shows the exterior of the long cold brooder house on Mr. Stocker's farm, and Fig. 10 is a portion of the interior of the same building showing the general arrangement of the cold brooders. The cold brooders on this farm have proved most successful and are similar to those in use at the Parafield Poultry Experiment Station, South Australia, which are most efficient to rear chickens from the time they are three weeks old until six weeks of age. The following description, and Fig. 11 (showing the design of the cold brooder) is given in Bulletin No. 365 by Mr. A. A. McArdle, Manager, Parafield Experiment Station, South Australia: "The cold brooders are capable of holding 80 chickens comfortably from three to six weeks of age. The length of the brooder is 5 ft. 6 in. and it is 2 ft. 6 in. wide—both internal measurements—and the height in front is 2 ft. 6 in. and at the back 2 ft. Wire-netting frames are used above the floors with very good results.

The brooder is kept in a sanitary condition and the dangers of crowding are avoided, as the chickens underneath, if crowding occurs, are able to obtain air. The brooder is divided into two sections; one for sleeping quarters, the other for feeding. The quarters are separated by a division 2 ft. 6 in. wide by 2 ft. high (front and back), constructed so that it can be lifted out if required.

The sleeping quarters are 2 ft. 6 in. by 2 ft. 6 in. and the run is 2 ft. 11 in. by 2 ft. 6 in. The uprights are outside the actual brooder box to allow the wire-netting frames to fit properly. These are constructed of 2 in. by 2 in. oregon and are one inch smaller than the size of the quarters as it is necessary to remove the frames for cleaning purposes. The mesh used is standard $\frac{1}{2}$ in., and it is advisable to cover the edge of the netting with a strip of galvanised iron. The sleeping compartment has a light frame 2 ft. 5 in. by 2 ft. 3 in. constructed of $1\frac{1}{2}$ in. by 1 in. oregon and covered with ordinary hessian, which is held in position by stops so that it is 12 in. above the wooden floor. These frames assist in keeping the chickens warm when first moved to the brooders but can be removed after seven or eight days. It is very necessary to see that for the first few nights the chicks are closed in the sleeping quarters. The entrance to the sleeping quarters is through a 6 in. by 4 in. opening which is equipped with a slide, and a similar opening in the front of the feeding compartment permits entry to the outside run. The roof is constructed in one piece and is hinged at the front of the brooder, allowing the whole roof to swing up to permit feeding and changing operations. The floor is constructed of flooring board supported on three 3 in. by 2 in. jarrah pieces 2 ft. 6 in. in length, the intervening gaps at the front being closed with 2 in. by 1 in. jarrah to prevent chickens getting under the brooder. Fig. 11 contains further details of construction.

In choosing a brooder system the main consideration must be the provision of conditions conducive to the rearing of sound healthy stock but the number of chicks to be reared, the saving of labour, and the capital outlay must be the deciding factors.

Brooder Operating and Chick Management.

Whatever system is used success depends very largely on sound management. Battery brooding will be referred to later, but with all other types of brooders there are certain fundamental practices and preparations that are essential. Under Western Australian conditions the best floor for a brooder house is a well-finished concrete floor with a smooth surface as it is easy to keep in a sanitary condition. If a new concrete floor is laid it should be completed at least four to six months before it is needed for the brooders as it takes months for green concrete to dry out. If the brooder house has been used in previous seasons it should be thoroughly cleaned, especially the floors, two or three weeks before the brooders are needed.

The floor of the brooder pen should be covered with litter to a depth of one to two inches. Several different types of litter have proved satisfactory and among these are dry clean sand, clean chaff, and white sawdust, but the essential point is to renew the litter as soon as it becomes foul or damp. This especially applies to the litter under the brooder which in spite of the heat may quickly become damp and badly soiled, and after the first few days should be changed daily. It has become common practice to place a cut-open bag under the brooder on which is sprinkled a small amount of litter, the bag with the "accumulated droppings" is removed each day and replaced with a clean bag and litter. The bagging can be cleaned and dried in the sun and used throughout the brooding season. Some poultry keepers find the use of a wire-netting

frame placed on the floor under the brooder is an aid to cleanliness. The frame is made of 2 in. x 2 in. timber covered with $\frac{1}{2}$ in. mesh wire-netting and is large enough to project about a foot beyond the edge of the brooder. A piece of sacking is placed on the wire-netting and replaced daily, as mentioned above, but when the chicks are about one week old the sacking should be removed and the chicks will walk on the wire netting. The wire frame allows air to circulate under the chickens and prevents any dampness under the brooder, and once the sacking is removed the droppings pass through the netting and the chickens are sleeping under more hygienic conditions.

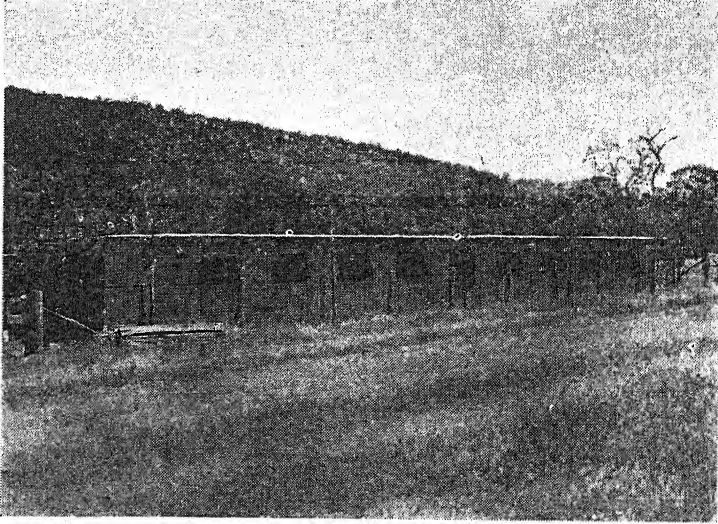


Fig. 9.
Exterior of Cold Brooder House on Mr. Stocker's Farm.

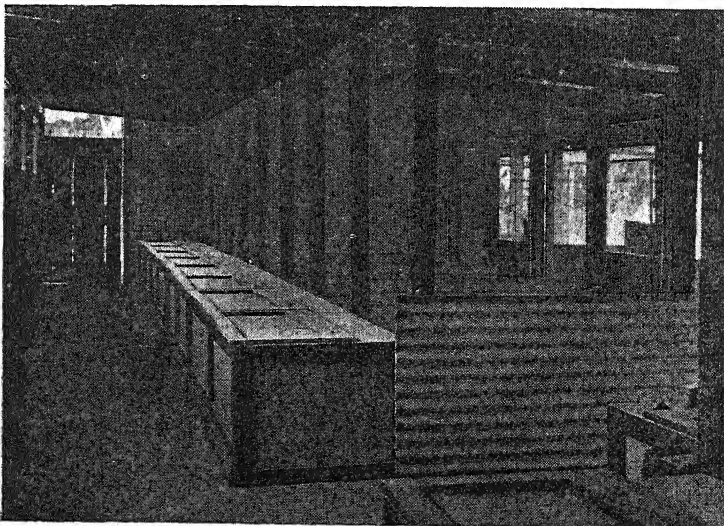
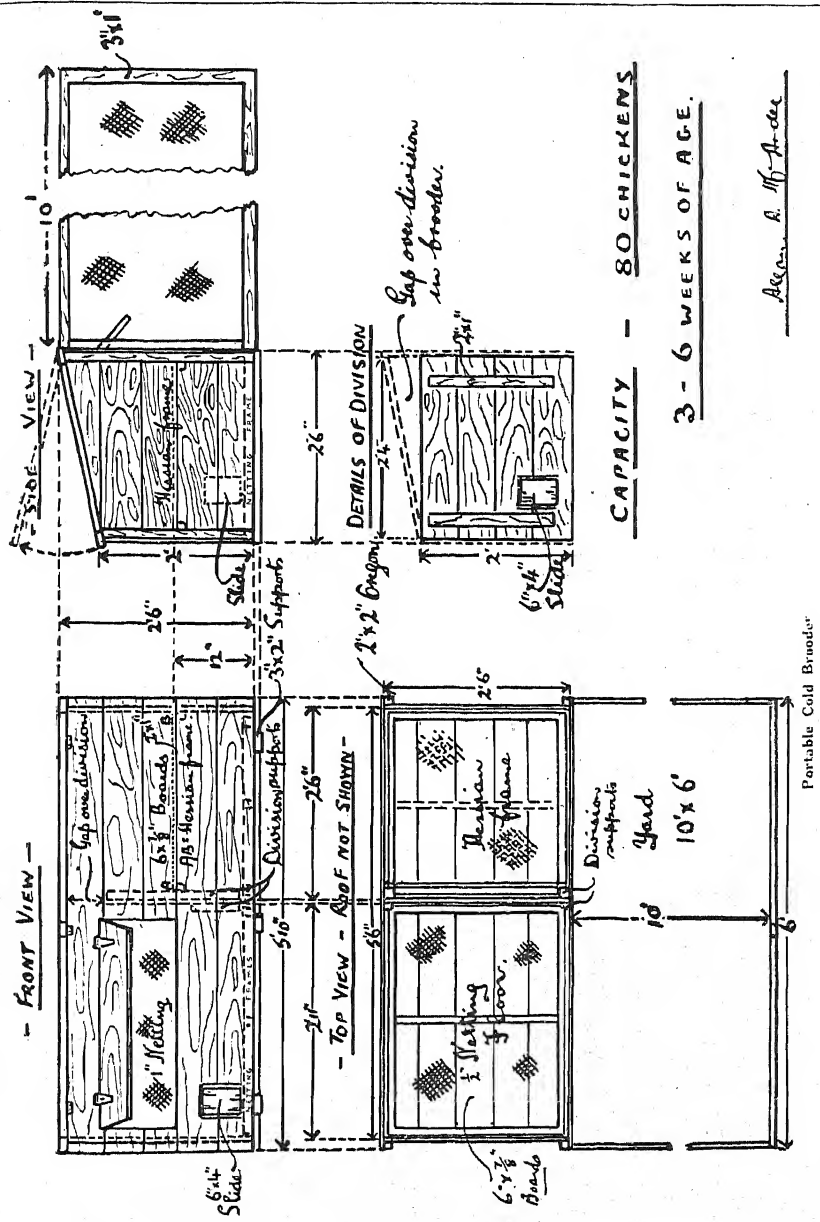


Fig. 10.
Portion of the interior of the Cold Brooder House.



Preparing the Brooder.

The brooder should be warmed up two to three days before it is actually needed so that the brooder and its surroundings will be thoroughly dry and warm before the chicks are placed in the brooder. If the brooder is controlled by a thermostat the necessary adjustments should be made before commencing actual brooding but if the brooder is not thermostatically controlled the temperature under the brooder should be checked by a thermometer. As a general guide, the

temperature under the brooder at chick-level, for the first week, should be about 90°F. During the second week the temperature should be 85°F. and lowered to 80°F. for the third week. Once the chickens have been placed under the brooder their conduct will indicate the temperature they require. An increase in temperature is indicated when the chicks crowd towards the centre of the brooder in an endeavour to obtain sufficient warmth, while a decrease is necessary when there are signs of panting and the chicks crowd away from the source of heat. The best results are obtained when there is sufficient heat to allow the chicks to spread themselves out comfortably under the brooder near its outer edge. When chicks are quite comfortable as regards warmth and feed they are comparatively silent but when a shrill chirping is heard it is a sign that something is wrong and it is usually that the brooder is not warm enough.

When chicks are placed under a brooder they must be confined to the brooder itself and its immediate surroundings. Day old chicks are liable to wander away from the source of heat, and apparently cannot find their way back and become chilled which may develop into pneumonia. To prevent this a circle of metal about 18 inches high is placed around the brooder. This guard should be placed about a foot away from the edge of the brooder and enlarged each day or two as the chicks become "brooder wise". The guard not only prevents chicks straying from the brooder but it prevents ground draughts rushing under the brooder, but it must allow chicks room to get away from excessive heat as chills are often caused by chicks being kept in overheated brooders.

Placing Chicks Under the Brooder.

The first step in successful brooding is to have the brooder ready for the chicks when they arrive by transport or from the incubator. When transferring the chicks from the incubator, or the boxes, great care must be taken to ensure that they do not catch a chill, but it is advisable to handle each chick, count them, and dispose of all weaklings as they are a possible source of disease. If the brooder is running at the proper temperature chicks may be placed in it at any time during the day. If chicks are transferred to brooders in the morning it will be noticed that a few of the vigorous ones will wander outside the brooder as far as the guard will allow, but a frequent watch will ensure that these chicks go back to the warmth. On the other hand, chicks put under in the late afternoon will often settle down quickly and will not come out until the next morning. The daily routine with the brooders should be cleaning under the brooders, checking on the temperature, keeping the litter in a sanitary condition, and allowing the chicks more space every day or two.

When to Allow Chicks Out Into the Yard.

No definite statement can be given as regards the age that chicks should be allowed out in a yard but, as a guide, after they are 5 days old and provided the weather is satisfactory, the quicker they are out in the sunlight the healthier they will become. Practical experience indicates that chicks which get out early on to the ground are hardy, healthy chicks, they feather correctly and grow quickly. For the first day or so they should be allowed out only for about two hours, and it should be at a time when there is no shadow in the yard for the chickens to stand in. It will be necessary to put the chickens back into the brooder house once or twice but after that they will soon learn to find their way back. After the first day or two the chicks will be anxious to get into the yard and provided the sun is shining and it is not extremely cold or wet they can be allowed

out all day. Care must be taken that the runway leading from the yard to the chicks' entry door of the brooder house is constructed in such a manner that the chicks cannot get beneath it, but rather, that a chick approaching from any direction has easy access to the entrance.

Weaning from artificial heat.

As the chicks grow more body heat is generated and at the end of about three weeks of artificial heat the chicks are either removed to a cold brooder for another three to four weeks or the temperature of their brooder is gradually reduced. Great care should be taken when the chickens are first moved into the cold brooders. If the weather is unfavourable they should not be allowed into the yards or if the brooder is of a portable type the chicks should be kept closed up for a day or two to avoid chills. If the weather is fine they are allowed a short period in the run on the first day, gradually increasing the time as they become accustomed to the cold brooder. It is evident that a chick which has been used to running in from the yard to a heated brooder will require careful treatment until it gets used to its new conditions. When chicks remain in the heated brooder they are generally ready for a gradual hardening off at three to four weeks. Turning off the heat for a short period in the middle of the day and gradually lengthening the period is the method usually adopted. At about this time it will be noticed that some of the chicks are either sleeping just outside the brooder or are perched on top of it, and this is an indication that weaning can be successfully carried out.

The gradual lowering of the temperature and the periods of no heat must be at the discretion of the operator as it is governed by climatic conditions.

At six to seven weeks old the chickens should be moved to the rearing sheds which may be either a semi-intensive shed or colony houses.

Management of Battery Brooders.

The modern battery brooder is practically fool-proof and provided the necessary procedure is carried out will rear a high percentage of healthy chicks. The best results are obtained when chicks are battery brooded for approximately three weeks and then moved to cold brooders for a further three to four weeks. If chicks are kept for more than three weeks in the battery they become crowded and there appears to be greater likelihood of mortality when they are placed in ground brooders. The temperature control of the brooder is based on 90°F. for the first few days, gradually reducing by easy stages to 80°F. during the third week. The brooder should be running for at least a day before it is required for the chicks, which are then placed in the warm section of the brooder. Newspaper is placed over the wire floor and renewed daily for three or four days, after which the chicks walk on the wire floor. A small area is allowed at the side of the warm portion where the chickens can feed and drink in partial warmth, and the area is enlarged from day to day. The battery rears a large number of chicks in a small space so it is important to keep it in a sanitary condition; the droppings must be cleared from the trays beneath the wire floors daily, and the brooder room must not be too hot but sufficiently ventilated to provide the fresh air required by such a large number of chicks. All movable parts of the battery should be thoroughly cleaned and disinfected between each brood of chickens, and the wire floors should be cleaned with a wire brush. A large container for soaking equipment is a necessary accessory for all battery plants. An important point is that rays of sunlight should not shine on to the wire floors, it will encourage the chicks

to commence picking at each other which may develop into feather pulling or toe picking. As the chickens cannot get into their food and water containers these brooders ensure that the food and water consumed is absolutely clean.

Management of Chicks After the Brooding Stage.

It has been common practice in Western Australia in recent years to crowd up the old stock and rear chickens in a vacant laying shed, probably because it saves the expense of special rearing sheds which would remain idle for eight months in the year. This practice is not good poultry husbandry as it means the young birds not two months old, are moved into sheds and yards which are stale, if not contaminated. Under these conditions it cannot be expected that the young birds will make satisfactory growth or develop into hardy, thrifty stock. There is too much risk of them becoming infested with worms or contracting disease through close contact with older birds. It has been noticed that young stock reared on stale ground do not develop evenly, there are too many culls and their unhealthy growing conditions must have an adverse effect on the future egg production of the pullets.

Most poultry farmers now realise that the best rearing results are obtained by the use of some types of colony system. Many types of colony houses are used with success, some are portable and others are permanently placed on the rearing ground.

The general farmer or orchardist, rearing two or three hundred pullets each year as a side line, could, with advantage, use a portable type of colony house. Fig. 12 is a copy of an illustration of a rearing coop for growing stock on range, published in a Poultry Bulletin by the Department of Agriculture, Tasmania. The structure is cheap to make, and is light in weight, rendering it easy to move to a new position, which should be done once each week. The floor is of small mesh wire-netting. Ample wide perches should be provided and raised not more than a foot from the floor.

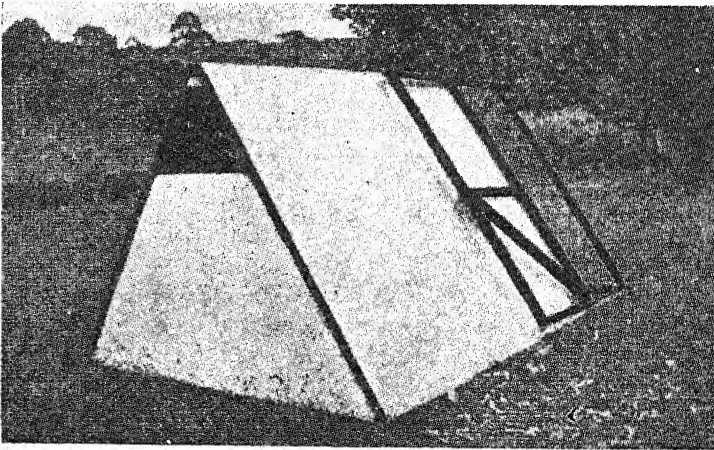


Fig. 12.

Rearing coops for growing stock on range.

Paddocks or orchards with an abundance of green feed and shade are ideal and will give excellent results. Incidentally the fertility of the soil will be improved, and better rearing results obtained, by using fresh rearing ground each year.

It is usual to surround the colony house with a temporary fence for the first week until the young stock get used to their new quarters, after which it can be removed and the stock allowed to range, but they will return to roost in their own house at night, even if they mingle with other birds from other sheds during the day.

For the commercial poultry farmer a restricted type of colony rearing is necessary. The aim should be to have rearing grounds where not more than 900 birds to the acre should be housed. An acre of land is divided into three large wire-netted enclosures and in each enclosure three rearing sheds are placed in such positions that they are as far apart as possible. Each shed is capable of holding 100 young pullets until they are ready to be moved to the laying sheds. It is desirable to have them quietly settled in the laying sheds two or three weeks before they come into lay, therefore, the time to move them is when the comb commences to develop and "reddden up."

Fig. 13 shows the type of rearing shed which has proved successful at Parafield Poultry Experiment Station, South Australia and Fig. 14 shows the interior of the same shed. Each house is 8 ft. long by 6 ft. wide, the front is closed up halfway with iron and an aperture 4 in. wide is left under the roof at the rear of the shed for ventilation purposes. The floor consists of a large wire-netted frame (1 in. mesh) which can be pulled out through a 3½ in. gap allowed at the front of the shed (3 in. above ground level). The use of this system of flooring allows of cleanliness and prevents losses due to smothering. The shed is equipped with four roosts supported 9 in. above the wire-netting, and the birds will commence to roost a few nights after being placed in the sheds.

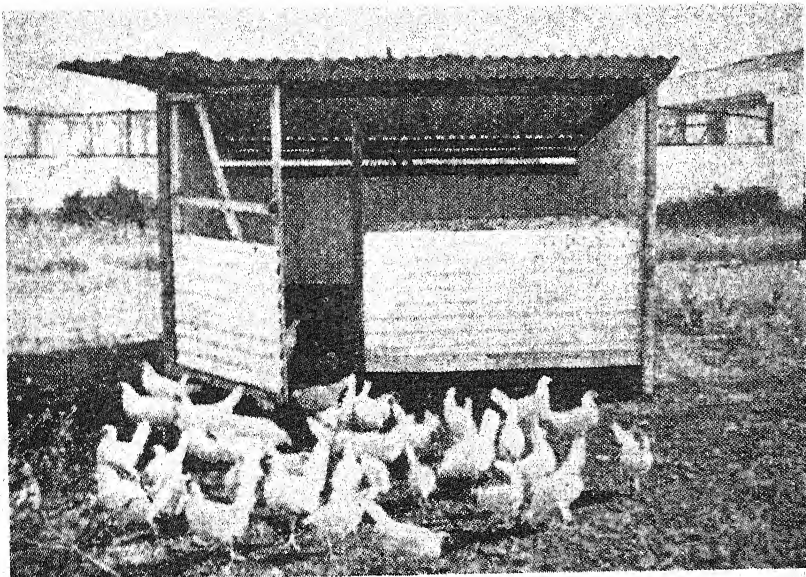


Fig. 13.

Rearing shed in use at Parafield Poultry Experiment Station.



Fig. 14.
Interior of shed.

The rearing grounds must be reserved for the young stock and must be kept vacant until required the next season. Shade trees should be planted in the yards as the birds will be in occupation during the warm weather. It is desirable to cultivate the yards and grow a crop of green feed which will be ready when the young stock are moved into the rearing sheds. This will aid in freshening the ground and provide additional green feed.

It was mentioned previously that it was necessary to build temporary yards around free range colony houses, and with restricted type of colony rearing it is also necessary to follow that procedure and to lock the birds in the house for the first week or so to prevent the young stock camping in the yard.

The Feeding of Chickens.

The system of feeding young chicks should be similar to feeding methods to be adopted when they become adult stock. It is general practice in Western Australia to use a mash and grain system and this appears to be suitable for most conditions. Many poultry farmers raise their chicks on dry mash and grain and at a later stage transfer to wet mash in the morning, dry mash in hoppers always available and grain in the evening. This procedure has given good results and can be regarded as a mash-grain system. Dry mash feeding reduces labour to a minimum, and pellet feeding, though very satisfactory, is at present rather expensive for general use.

Whatever the system of feeding adopted, it must be remembered that wholesome, highly digestible food is essential and must be given regularly, and no rapid changes of feed must take place.

The equipment used for feeding and watering the chickens must be kept scrupulously clean, and of such a type that the chicks cannot pollute the water or feed. There are several different types of these utensils on the market and as the majority are based on practical experience it should not be difficult to purchase suitable equipment. It must be understood that day old chicks will require feeding and watering utensils suitable to their size, and as the chickens grow larger, the utensils must be replaced by larger ones. Water vessels should be cleaned and filled with fresh water daily. Plenty of feeding space at the hoppers is essential; the circular hopper appears to be more satisfactory than the straight sided one in this regard. The ideal hopper should enable the chickens to feed easily, prevent waste, and be sanitary. It is good practice to mount the water fountains and feed hoppers on frames covered with $\frac{1}{2}$ inch mesh wire. Spilled water goes below the wire and chicks do not come into contact with damp litter, and chicks are prevented from picking up small quantities of mash which may be spilled from the hopper and contaminated with droppings.

In the past opinions have varied considerably as to when the chick should receive its first feed, and it was considered advisable to delay feeding for 36 to 48 hours after hatching. There is no evidence to support this theory but experiments and practice indicate that the chicks may be given feed as soon as they have settled down in the brooder. If the chicks have been received from a hatchery they may be many hours old and water, shellgrit, and feed should be made available immediately, but it will be noticed that only some of the chicks will eat and it may be many hours before all the chicks will have eaten their first feed. Chicks may be fed in hoppers from a day-old but it is advisable to place additional dry mash on brown paper for the first day or two. A chick naturally picks at a light coloured object and as the feed shows up on the dark background of the paper it is not long before all the chicks are picking at the feed.

Chick rations should be well balanced and contain all the essential nutrients in the correct proportions because the chick eats and drinks frequently as its crop is too small to store a large amount of food, and the mixture used must be such that it is unlikely to give rise to digestive troubles. If very finely ground materials are used in a dry mash, and the materials are of such a nature that they stick together when damped then the materials may bind together forming a hard pad on the inner surface of the beak, and balling of the food may occur in the digestive tract retarding the work of the digestive juices, and causing digestive disturbances. If quick growth is required the rations should supply as much food in excess of that required for maintenance as the bird can eat, therefore the mash must not be excessively bulky.

If chicks receive grain during the first four weeks, growth is retarded because the consumption of mash containing the necessary proteins, vitamins and minerals is limited and they are practically forced to consume an unbalanced ration.

Composition of Chick Rations—Use of Oats.

In Western Australia it has been common practice to compound the chick mashes from wheat offals with meal and buttermilk as the supplementary proteins. Is this practice in the best interest of the industry?

Biester and Devries in "Diseases of Poultry" have collected some interesting data on feeding oats to promote growth in chickens. They state that "some of the cereal grains are more effective than others in promoting growth and normal tissue structure in chickens. Chicks fed diets made up with single cereal grains, a single source of supplementary protein, and with appropriate

vitamin and mineral supplements, varied widely in both body growth and quality of feathering. It has been found that chicks fed on oats and milk diet grow more rapidly than those which are fed wheat and milk or barley and milk, but a combination of barley and oats proved to be fully as effective as oats alone.

Chicks may be reared successfully on diets made up of oats and milk with proper vitamin and mineral supplements when oats make up as high as 80 to 85 per cent. of the total diet. It has been found that ground oats in the diet are more effective than hulled oats which were formerly considered the superior feed. In experiments on rate of growth in chicks, it has been found that the chicks fed ground whole oats will invariably grow faster, followed by those fed barley, wheat and corn in the order named. Fig. 15 shows the rate of growth of chickens fed on an oat diet compared to growth on other cereals.

While wheat is a very good source of poultry feed, it should not be fed in unrestricted quantities, since there are reports indicating that chicks fed on high wheat diets grow slowly and with a high percentage of mortality.

When oats are used, the proportion of hulls does not seem to affect the result greatly, provided the weight of the oats exceeds 24 lbs. per bushel. As a result of this work, it is recommended that a mixture of grains should be used in making up a diet for chicks, and that gristed whole oats should be included in the mash.

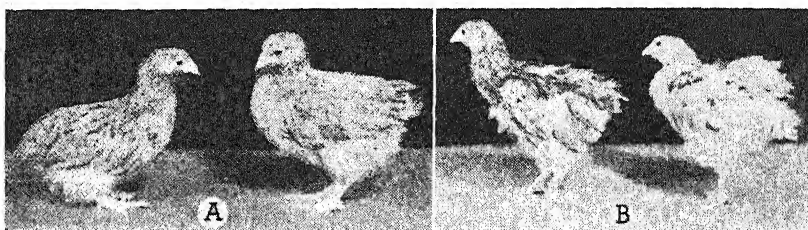


Fig. 15.

A.—Chicks fed a diet of ground whole oats, dried skim milk and mineral and vitamin supplements.
B.—Chicks received a diet of corn, dried skim milk with similar supplements. Both diets were fed at the same level of protein.

From the above information it would appear that in making up a chick ration whole gristed oats should be included to promote rapid growth. There is, also, another aspect of oat feeding which should be considered for it is based on recent research work by T. Barton Mann and published by the Cambridge University Press in the *Journal of Agricultural Science*. His work shows how profoundly mortality from bacillary white diarrhoea (pullorum disease) is affected by the kind of food fed to chickens. The work indicates that the most speedy method for the eradication of bacillary white diarrhoea is a combination of blood testing and nutrition and that foods capable of producing intestinal putrefaction must be withheld from the diet of chicks, and growing stock. With regard to foods: chicks should receive crushed grain for the first feed and thereafter for 72 hours to encourage an acid digestive tract. Foods containing processed proteins should be introduced to the diet in a gradual manner in order to give the chick an opportunity to acquire immunity to the organisms which these foods encourage, and such foods should not be fed in excess. After the introduction of these foods, gristed oats should be supplied for one complete feed of the day in an endeavour to produce one period in the 24 hours in which an acid reaction obtains throughout the whole length of the alimentary canal.

Abundant succulent green food should be supplied as a source of vitamins for protective factors. If an all-mash diet is fed, it is the opinion of that research worker that the protein content should not exceed 14 per cent. and the supplementary protein should consist mainly of milk.

The feeding tests on day-old chicks, carried out by this research worker, demonstrated the high mortality which occurred when National Baby Chick Mash (Protein 20 per cent.) formed the sole diet and the low mortality when gristed oats were substituted for one feed of mash and which lowered the total protein intake to 14 per cent. Provided they were given access to pasture at an early age, the chicks made steady growth and after the introduction of lowered protein feeding and a higher intake of green food, mortality from bacillary white diarrhoea declined.

The following is an extract from one of the feeding tests and is most interesting. The day-old chicks were fed National Baby Chick Mash obtained from two different manufacturers and it was fed as the first feed to the chicks in compartments one, three, four and six in the brooder house. For the chicks in compartments two and five the gristed oats were mixed with the National Baby Chick Mash and it was noticed that they were able to select the oats because of their size in the mash. One group of sister pullets was placed in compartment eight immediately after the previous tenants, the surviving chicks of a previous experiment had been removed (mortality had been 76.6 per cent.). The brooder was not disinfected and the only attempt at hygiene was to change the chaff litter. These day-old pullets received crushed oats only as the first feed and thereafter for 72 hours followed by N.B.C.M. for two feeds a day and crushed oats for one feed per day. Table I is an extract from a table showing the per cent. of mortality as influenced by oat feeding.

Table I.

Com-part-ment No.	N.B.C.M. Source.	Details of Feeding.	Total Protein Intake.	No. of Chicks.	Deaths to 8th Day.	Mor-tality.
			%			%
1	A.	N.B.C.M., 2 feeds per day : crushed oats, 1 feed per day.	14	53	15	28.3
2	A.	Crushed oats 40% mixed with N.B.C.M., 60%, 3 feeds per day	16	53	11	20.7
3	A.	N.B.C.M., 3 feeds per day ...	20	78	61	78.3
4	B.	N.B.C.M., 2 feeds per day : crushed oats, 1 feed per day	14	53	22	41.5
5	B.	Crushed oats 40% with N.B.C.M. 60%, 3 feeds per day	16	53	14	26.4
6	B.	N.B.C.M., 3 feeds per day ...	20	54	36	66.7
8	A.	Crushed oats first 72 hours, then crushed oats 1 feed per day ; N.B.C.M., 2 feeds per day	14	58	1	1.7

The research work carried out by T. Barton Mann indicates that chick reavers in Western Australia should include a proportion of gristed oats in the mash in an endeavour to reduce the incidence of pullorum in chickens. Statistics compiled from official records by the Government Statistician disclose that the yield from the principal grain crops of Western Australia for the 1945-46 season was approximately 21 million bushels of wheat, four million bushels of oats and 666,000 bushels of barley.

The export of wheat from Western Australia for 1945-46 was approximately 13½ million bushels so the difference between production and export for that year was 7½ million bushels. However, this amount would be for all purposes and it is probable that the wheat available for stock feeders would approximate the oat yield for the year. From the figures given it would appear that it should be possible to substitute oats for a portion of the wheat used by the poultry farmer.

Level of Protein in Chick Rations.

Protein levels and sources for both growth and egg production have been investigated by many research workers and there appears to be a general agreement as to maximum and minimum levels. The maximum being the level above which no further response can be expected and the minimum below which development is appreciably retarded. A review of the data available indicates that the maximum is approximately 21 per cent. and the minimum 13 to 14 per cent. for chickens in the first six to eight weeks of their growth, but maximum growth in pullets is not necessarily the most satisfactory growth.

Research work in the level and source of protein in poultry production as related to economical production of growth in pullets was undertaken by Gutteridge, O'Neil and Pratt of the Poultry Division, Experimental Farms Service, Department of Agriculture, Ottawa, Canada and results of their investigations have been published in "Scientific Agriculture." They point out that "From a physiological standpoint the greatest body weight in a given time may not mean the production of the most sound individual. Under these conditions, moreover, the feeds may not be used as efficiently for the production of gain in weight. In addition, rapid growth may be occasioned at a greater cost in consumption of feed containing high priced ingredients than the value of the increased weight of the bird would merit." A summary of their work to determine the comparative efficiency for rearing chickens on different levels of protein from vegetable or animal sources averaging approximately 12.5 per cent., 14.5 per cent., and 17 per cent. can be stated as follows:—12.5 per cent. of protein was too low and that, with reasonable supplementation by pasture, the medium level closely approximated the highest level in results, actually surpassing it with respect to efficiency of use of protein and economy of production of body weight. It was further determined that a level of 14.5 per cent. of protein gave equally as satisfactory results as those from a 16.5 per cent. level during the period of egg production following. From the points of view of growth and efficiency of utilisation vegetable proteins were inferior to animal proteins. Mortality was consistently higher on all levels of vegetable protein but, in general, the results obtained were reasonably satisfactory, and in time of scarcity of suitable animal proteins they could become useful substitutes.

The final summary on these experiments stated: "In consideration of the results obtained as judged by all the above criteria, it is concluded that feeding a 15.5 per cent. protein mash to seven weeks followed by a systematic reduction of protein by dilution with scratch grain so that a ratio of 3 parts grain to 1 of mash (13.7 per cent. protein) was reached at 24 weeks (average protein ingestion of 14.5 per cent.) may be expected to give as satisfactory results as the usual practice of 20 per cent. to 14.75 per cent. with a 17 per cent. average when pasture is available."

Table II is an extract from tables showing the schedule of feeding and protein levels actually consumed considering both grain and mash (15.95 per cent. protein). The scratch grain used in this experiment was a mixture of wheat, cracked

corn, oats, barley, buckwheat, sunflower seed and milo maize, which analysed 12.93 per cent protein. Protein supplements of the mash were meatmeal, fishmeal, and dried skim-milk.

Table II.

1- 7 weeks inclusive	...	...	Mash only	...	...	...	15.95% protein
8-10 " "	...	...	4 parts mash :	1 part grain	...	...	15.35% protein
11-13 " "	...	...	3 parts mash ;	1 part grain	...	...	15.19% protein
14-16 " "	...	...	2 parts mash ;	1 part grain	...	...	14.94% protein
17-19 " "	...	...	1 part mash ;	1 part grain	...	...	14.44% protein
20-22 " "	...	...	1 part mash ;	2 parts grain	...	...	13.94% protein
23-24 " "	...	...	1 part mash ;	3 parts grain	...	...	13.68% protein
Average	...	...	...	...	...	...	14.69% protein

The object in citing these several experiments is an endeavour to demonstrate that recent research indicates a better method of feeding day-old chicks than is common practice in Western Australia today, and that it is possible to rear healthy, well grown chicks with the feeds available in spite of the shortage of meatmeal.

In practically every country where oats are grown it has been the practice to include a percentage of oats in poultry feeds but the use of that grain has probably not been considered in Western Australia because of the quantity of wheat always available. However, with the suggested feeding of chicks which is given below it is necessary that the chicks be allowed out on pasture as early as possible, or that they be given an abundance of succulent green stuff at an early age. Greenfeed should be given to chicks when they are four or five days old as it will be two or three days before they will eat readily of this feed. The schedule of feeding is—

- (a) 1-3 days inclusive Gristed oats.
- (b) 4 days to 8 weeks inclusive ... Dry mash, plus 1 feed of gristed oats, plus greenfeed.
- (c) 9 weeks to 24 weeks Wet mash in the morning, plus dry mash in hoppers, plus 1 feed of grain, plus greenfeed.

Explanation—

(a) The oats should be crushed sufficiently that they break up to allow the small chick to feed easily.

(b) Dry mash is placed in one feed hopper and is available to the chick for the greater part of the day. Gristed oats are placed in another feed hopper which remains closed for most of the day. When the attendant visits the brooders in the evening, after all the chicks are under the brooders, he closes the gristed oat hopper and opens the mash hopper, so that the mash will be available to the chicks when they come out in the morning.

As stated previously, chicks feed many times in the day and it must be the object of the attendant to close the mash hopper and open the one containing gristed oats at such a time that the chickens will consume gristed oats for their last feed prior to the greenfeed which should be the last feed of the day. It is not possible to state the exact time for the opening of the gristed oat hopper but it would be approximately 3 p.m.

The mash should be made up as follows:—

Table III.

Foodstuffs.	Amount by Weight.	By Volume Kero tins.	Crude Protein.	Calcium.	Phos- phorus.
	lbs.				
Wheatmeal	32	1— $\frac{1}{3}$	3.2	0.01	0.06
Bran	30	2— $\frac{1}{3}$	4.2	0.02	0.18
Gristed Oats	30	1— $\frac{2}{3}$	2.7	0.01	0.06
Meatmeal	8	— $\frac{1}{3}$	4.0	0.64	0.32
Dried Buttermilk	4	— $\frac{1}{3}$	1.4	0.05	0.04
Bonemeal	2	...	0.4	0.40	0.24
	106	6— $\frac{1}{3}$	15.9	1.13	0.90
100 lb. contains ... ..	...	...	15.0	1.07	0.85

The mash consumed by the chicks during the day has a protein content of 15 per cent. but the last feed of the day of crushed oats has a protein content of nine per cent. The probable intake of feed would be in the ratio of four of mash to one of crushed oats and this would result in a total intake for the day of approximately 14 per cent.

It must be again emphasised that abundance of succulent greenfeed must be provided, and it must be realised that the protein intake from this source has not been taken into account.

(c) For this stage of the rearing two methods of procedure are possible but the one chosen must conform to the feeding system the pullets will receive during their laying life. If the system of feeding on the farm is dry mash the growing chickens should be allowed free access to the mash hoppers throughout the day. The crushed oats, previously given as the last feed of the day, can now be replaced by a scratch grain mixture containing equal quantities by volume of wheat and oats. That is, one bushel of wheat should be mixed with one bushel of oats, and the growing stock should be fed an amount they will clean up within half an hour. As standard weight of the bushel of wheat and oats are respectively 60 and 40 lbs. this grain mixture will be approximately in that proportion and will have a crude protein content of about 9.6 per cent. As there is a rapid increase in food consumed in the period when chicks are seven to ten weeks old it is reasonable to expect that the ratio of mash to grain will be three of mash to one of grain, and the protein intake for the day would be 13.65 per cent.; which figure does not include the protein contained in the greenfeed. The importance of rearing the growing stock on pasture or feeding ample supplies of greenfeed must be again stressed.

The amount of food consumed per chick per week is interesting, namely:—

Age in weeks	...	...	1	1-3	3-7	7-10	10-15	15-20	20-24
Food in ozs.	...	...	2	3	6	15	19	24	22

If the system of feeding the laying flock on the farm is the one popular in Western Australia, that is wet mash in the morning, dry mash in hoppers and always available, and wheat followed by greenfeed in the afternoon, then the growing pullet from nine weeks onward should receive a wet mash in the morning. The wet mash should consist of equal parts by volume of chaffed

green stuff and the mash mixture, and should be damped with water or skim-milk to the proper consistency. During the day dry mash should be available in the hoppers and the grain mixture, previously described, fed in the afternoon and followed by greenfeed.

Finally, the authors hope that the practical suggestions advanced and the review of recent research work may be of some assistance to poultry farmers. In all stock raising, environmental conditions may change the method or procedure, therefore the contents of this article must be used as a general guide and may be varied according to special circumstances.

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Tetanus in Farm Animals.

C. R. TOOP, Assistant Chief Veterinary Surgeon.

THE disease tetanus occurs in practically all of the animals and man. It is caused by the tetanus bacilli (*clostridium tetani*) and results from contamination of wounds and raw surfaces with material such as earth or dust containing these organisms.

The tetanus bacillus is widely distributed in nature and frequently occurs in the soil of cultivated land, in stock yards and in animal manure. Upon gaining access to a wound tetanus bacilli show no tendency to invade the body by way of the blood circulation and set up a general infection, but remain localised at the site of infection where they multiply and in the process elaborate an extremely potent toxin. Tetanus toxin is one of the most powerful of the known poisons. It has a special affinity for nervous tissues by which it is readily absorbed and which it stimulates to produce the spasmodic muscular contractions so characteristic of the disease. The tetanus bacillus is an anaerobe which thrives in the absence of air. Consequently deep punctured wounds from which air is excluded are more dangerous than large superficial ones. Any wound, however, may become infected and particularly if it contains dead or necrotic tissue or has become covered over by accumulated discharges and scabs. The incubation period of the disease, i.e. the period which elapses from the infection of the wound until the appearance of symptoms, ranges from 3 to 21 days but is usually about 7 days.

Of the domesticated animals the horse is the most susceptible but under the conditions which obtain in Western Australia the most frequent and most serious losses from the disease occur amongst sheep. Cases occurring in horses are for the most part isolated ones and are sometimes a sequel to nail punctures in the feet, stake wounds, harness galls, or castration. Amongst sheep mortalities involving the loss of a considerable number of animals are from time to time encountered and are generally associated with marking and shearing. The disease occurs much less frequently in cattle and pigs. The mortality rate is high; 75 to 80 per cent. of horses and cattle which become affected die of the disease while in the smaller animals such as sheep and pigs, recovery rarely occurs. Treatment of the disease is not usually attended by satisfactory results and is only worth attempting in horses and cattle.

As a means of preventing the disease attention should in the first instance be directed towards the adoption of "clean" methods in connection with lamb marking, castration and other operations. This will involve the use of clean temporary yards, the sterilisation of instruments by boiling before use, and the observation of antiseptic precautions. Since the wounds may, however subsequently become contaminated by earth or dust from sheep yards or paddocks, these precautions will not necessarily provide an adequate safeguard against infection and on properties where tetanus is prevalent some more reliable method of prevention should be employed.

The most effective and practical method of preventing the disease is provided by vaccination with tetanus toxoid. Inoculation with this product produces a strong and lasting immunity which develops after an interval of 10-14 days from the time of injection and will protect the animal against the disease should it subsequently become exposed to infection. Tetanus toxoid is especially valuable for the prevention of outbreaks of tetanus associated with shearing. Resort may also be had to the use of tetanus anti-toxin. In contrast with the enduring active immunity conferred by tetanus toxoid, the passive or borrowed immunity resulting from the injection of tetanus anti-toxin is of short duration, lasting only two to three weeks. Its effects, however, are immediate and if given at the time when the wound is inflicted it will tide the animal over the danger period while healing is occurring.

TETANUS IN SHEEP.

The majority of the outbreaks of tetanus which occur in sheep are associated with marking or shearing and result from the infection of castration, tailing and shear cut wounds. Such mortalities may be serious resulting in the death of a considerable number of animals. In new-born lambs infection of the navel cord may take place before healing has occurred. In a few isolated instances mortalities from tetanus have been encountered in sheep following upon inoculation with vaccines for the prevention of other diseases. Such mortalities may be attributed to careless methods including the contamination of vaccines exposed in open containers, to dust containing tetanus spores or failure to sterilise syringes and needles before use.

Symptoms in Sheep.

With the onset of symptoms the gait becomes stiff and stilted and the animal is soon unable to stand. Sheep affected by tetanus are almost invariably found stretched out on their sides with the legs rigidly extended and the head and neck bent backwards (but sometimes downwards or to one side). Characteristically the muscles are in a condition of rigid contraction and the body is stiff and board-like. This will be particularly noticeable upon lifting the affected animal from the ground. In many cases due to contraction of the masticatory muscles the jaws are locked together and the mouth cannot be

opened, this condition being known as trismus or "lock-jaw." A moderate amount of tympanitis or bloating is a constant feature of the disease. Tetanus in sheep is almost without exception, fatal, death occurring within a few days from the appearance of symptoms.



A lamb affected by tetanus following marking. Note the rigidity of the limbs and the retraction of the head and neck.

Prevention.

Hygienic precautions. Since the disease results from the contamination of wounds with tetanus bacilli or spores contained in the soil, hygienic precautions should always be adopted whenever the likelihood of such infection exists. These will be particularly applicable in connection with lamb marking. Old sheep yards which are likely to be heavily contaminated should be avoided and marking operations should be conducted in a well grassed temporary enclosure, erected in a convenient corner of the paddock, from hurdles or other suitable material. Instruments should be sterilised by boiling before use and when not actually in use they should be placed in an antiseptic such as a 2 per cent. solution of lysol (lysol 1 fluid ounce, water $2\frac{1}{2}$ pints). Following marking, lambs should be set down carefully so that the wounds do not come into contact with the ground. Prior to the commencement of shearing, sheds should be given a thorough cleaning and shearcuts should be dressed with tincture of iodine. Following shearing or marking, sheep should be released into clean, well grassed paddocks. Since infection of the wounds may subsequently occur in yards or paddocks by contamination with earth or dust, the application of hygienic precautions may not always succeed in preventing the disease and upon properties where recurrent losses from tetanus have occurred, other methods of control must be employed.

Immunisation with Tetanus Toxoid.

Vaccination with tetanus toxoid provides the most effective means of preventing the disease. Inoculation with this product confers upon the treated animal, a strong and lasting immunity which develops after an interval of

about 14 days from the time of injection. The dose of tetanus toxoid for the sheep is 1 c.c. given subcutaneously (beneath the skin) and the cost of treatment is approximately a penny per head. Tetanus toxoid will be found especially valuable for the prevention of outbreaks of tetanus associated with shearing. Vaccination must be completed not less than 14 days prior to the date upon which shearing is timed to commence and may thereafter be relied upon to afford a high measure of protection.

Tetanus toxoid might also be employed for the protection of lambs following marking. Since lambing, however, is usually spread over a period of six to eight weeks during which time lambs are dropping irregularly and vaccination must be carried out at least 14 days in advance of marking, this method of prevention may not generally be found practicable.

Tetanus Anti-toxin.

Alternatively lambs may be protected against the disease by the injection of tetanus anti-toxin given at the time when marking operations are performed which will immediately provide them with a passive immunity of two to three weeks' duration. Tetanus anti-toxin is a serum prepared from horses which have been immunised by repeated injections of tetanus toxoid. Blood from such immunised horses is drawn from the jugular vein into a sterile container and allowed to stand for 24 hours. The clear fluid or serum which separates upon standing is drawn off, suitably preserved, and standardised. This serum contains immune bodies or anti-bodies which are able to neutralise tetanus toxin. The immunity conferred by tetanus anti-toxin becomes effective within a few hours after the injection of the serum but it is of short duration lasting only two to three weeks. It is a passive immunity which will last only until the anti-toxin has been eliminated from the body. It, however, serves to protect the animal during the period while the healing of the wound is occurring.

The dose of tetanus anti-toxin for sheep and lambs is 100 units (U.S.A.) given subcutaneously. In order to obtain accurate dosage it is necessary that the required dose (100 units) of anti-toxin shall be contained in a given amount—say .5 c.c.—of serum and whenever the immunisation of lambs with this product is contemplated it is necessary to make special arrangements with the Commonwealth Serum Laboratories who supply the serum to put it up in such form that the above requirements will be fulfilled.

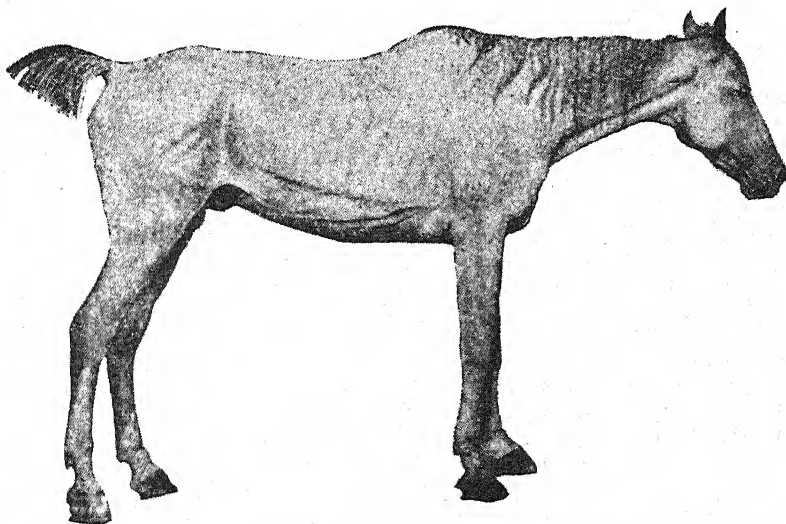
If it is desired to prolong the duration of the immunity simultaneous inoculation with tetanus anti-toxin and tetanus toxoid may be practised 100 units of anti-toxin being injected beneath the skin of the thigh on one side and 1 c.c. of toxoid being injected into the opposite thigh. By this means both an immediate and enduring immunity will be obtained which should protect the lamb from any ordinary infection to which it may become exposed and should tide it over the first shearing.

TETANUS IN THE HORSE.

Tetanus in horses is most frequently associated with wounds of the lower portions of the limbs such as nail punctures in the feet or penetrating wounds caused by stakes and other objects. The disease is a not infrequent sequel to castration particularly when this operation is performed in stable yards. It may also result from the infection of saddle and harness galls and other surface wounds.

Symptoms in the Horse.

As in the other animals, tetanus in horses is characterised by spasmodic contraction and stiffening of the body musculature. This usually commences in the muscles of the head and neck but rapidly extends to other groups of muscles. In an advanced case the affected animal stands stiffly with the fore-legs spread widely apart; the neck is extended, the tail is held rigidly and somewhat elevated and the abdomen is tucked up. The nostrils are dilated and trumpet-like; the ears are erect and the lips are drawn back exposing the teeth. Protrusion of the membrana nictitans (third eye-lid or haw) from the inner corner of the eye is a characteristic feature of the disease and this will become very pronounced when the head is elevated by a hand placed beneath the lower jaw. Affected animals feed slowly and seem to have difficulty in swallowing. In many cases due to contraction of the masseter muscles the mouth cannot be opened and although the appetite remains good the animal is unable to feed. This closure of the jaws is known as trismus. The muscles of the body are hard and board-like to the touch and this will be very apparent when the hand is placed upon the rump of the affected animal. The animal moves with a stiff straddling gait and has great difficulty in turning and backing. The joints are stiff and can only be flexed by the application of considerable force. Horses affected by tetanus are very sensitive to sound and light and when suddenly disturbed the muscle spasms may be increased to such an extent as to cause the animal to fall to the ground. The mortality rate is very high, the disease terminating fatally in from 75 to 80 per cent. of cases. Death usually occurs in from 3-10 days but should the animal survive for a fortnight the prospects of ultimate recovery are reasonably good.



A horse affected by tetanus.

(After Hulyra and Maek.)

Prevention.

In localities where tetanus is prevalent, wounds should receive special attention and should be regularly cleansed and dressed with an antiseptic preparation. When operations such as castration are to be performed aseptic precautions should be observed. Instruments should be sterilised by boiling and the skin at the site of the operation swabbed with tincture of iodine. The

horse should be cast on a clean well grassed area, stock yards and stable yards being avoided. The injection of 500 units (U.S.A.) of tetanus shortly after a wound has been sustained or when an operation is about to be performed, will in most cases protect the animal from infection during the ensuing period of 2-3 weeks while the wound is healing. As in the case of sheep, vaccination with tetanus toxoid produces in the horse a strong and enduring immunity and this might well be adopted as a routine procedure on all properties upon which the disease occurs. The dose of tetanus toxoid for the horse is 10 c.c. given subcutaneously. A second injection of 10 c.c. given after an interval of a year will confer upon the animal a life-long immunity.

Treatment.

The treatment of tetanus in horses does not offer very favourable prospects of success. In the first place the wound should be sought and thoroughly disinfected. All discharges and dead or necrotic tissue should be removed and this should be followed by regular dressings with an antiseptic such as tincture of iodine. The animal should be placed in a quiet dark loose box and disturbed as little as possible. The diet should consist of soft easily digested food such as green stuff, bran mash or boiled oats or linseed. When the animal is unable to masticate, liquid foods such as thin gruel or sloppy bran mash should be made available. The bowels should be regulated by the administration of magnesium sulphate (Epsom salts) in the drinking water.

Tetanus anti-toxin is sometimes used in the treatment of the disease but since this product can have no effect upon the toxin which has already combined with the nervous tissues and can only neutralise toxin which may continue to be produced at the site of infection, its value as a curative is extremely doubtful. Very large doses of anti-toxin repeated at frequent intervals must be employed and since this is expensive its use can only be justified in the treatment of very valuable animals. The treatment of the disease is always difficult and whenever possible veterinary assistance should be obtained. Some recoveries will occur with treatment but the outlook cannot be generally regarded as very hopeful.

TETANUS IN OTHER ANIMALS.

Tetanus is not very frequently met with in other animals. In cattle it sometimes occurs after calving when it may be associated with retention of the afterbirth or metritis (inflammation of the uterus), while in calves it may be a sequel to castration. The symptoms in cattle are very similar to those exhibited by horses and include general muscular stiffness, trismus (locking of the jaws), protrusion of the membrane nictitans and bloating.

Tetanus is uncommon amongst pigs but may occur as a sequel to castration, and is rarely seen in dogs. In these animals the symptoms follow much the same pattern as those shown by other animals and the disease is nearly always fatal.

Rations For Laying Hens.

The Comparative Costs of Alternative Rations.

L. C. SNOOK—Animal Nutrition Officer.

IN the March issue of this Journal R. H. Morris, an officer of the Poultry Branch of the Department of Agriculture, described a comprehensive poultry feeding experiment now being carried out at Muresk Agricultural College. This experiment has been designed to answer some of the more urgent questions to which the poultry industry would like answers. Unfortunately the answers will not be obtained quickly, as poultry feeding experiments are essentially "long term" undertakings. Before a ration can be said to have proved itself it must be known to keep fowls in good health and steady production throughout the year. So rather than wait until the experimental results are available it may be helpful to describe the rations which were selected, and to explain why certain food mixtures were used. This will permit practical men to follow the experiment with greater interest. Possibly the rations themselves, along with the relative costs of the various mixtures, may prove useful as examples to those who are keen to prepare balanced rations at a minimum cost.

Before working out rations it is first necessary to know just what are the nutritive requirements of the laying hen. These requirements have been investigated very thoroughly right down to individual vitamins and the millionth part of trace elements such as manganese. Fortunately, the producer who feeds his birds the usual mixed rations, along with a reasonable amount of greenstuff, rarely has to worry about the lesser known essentials and in this article discussion will be limited to three major constituents:—protein, calcium and phosphorus.

Protein.

If fowls are to be kept in steady production the ration should contain about 12 per cent. of *digestible* protein, this to include a certain proportion of protein of animal origin. Meatmeal is in general use to supply this protein but where skim milk is available this forms an ideal supplement for poultry. The proteins in milk are of high quality and small amounts will often exert quite a beneficial influence. As a rough rule it may be taken that, where meatmeal is used, one fifth of the protein fed to the birds should come from the meatmeal.

Calcium.

Every farmer is aware of the great importance of calcium (or lime) in the rations of livestock. Laying hens, in particular, require ample supplies of this element for the production of good quality egg shells. This is shown by the fact that while growing chicks require about 1 per cent. of calcium in their diet, laying hens should receive about 2.4 per cent. in order to satisfy bodily needs and produce good quality eggs with sound shells.

Phosphorus.

For optimum results the ration of the laying hen should contain about 1 per cent. phosphorus. Cereal grains and their by-products are generally quite well supplied with phosphorus and for this reason most poultry rations contain

reasonable amounts of this element. It will be noticed, however, that a certain amount of bonemeal rich in phosphorus has had to be added to all the rations discussed in this paper.

TABLE I.
Foodstuffs for Poultry.
Cost and Nutritive Value.

Foodstuff	Cost in Perth, June, 1947.	Cost per 100 lb. (pence)	Protein per 100 lb.		Calcium (Ca) per 100 lb.	Phos- phorus (P) per 100 lb.
			Crude.	Digest- ible.		
Wheat ...	6s. 2½d. per bus- hel of 60lbs.	124	10	8	0.04	0.22
Oats ...	4s. 5d. per bus- hel of 40 lbs.	132	9	7	0.05	0.22
Bran ...	£7 15s. 5d. per short ton	93	14	10	0.07	0.60
Pollard ...	£7 15s. 5d. per short ton	93	13.5	10	0.05	0.32
Peas ...	10s. per bushel of 60 lbs.	200	22	18	0.06	0.38
Meatmeal ...	£15 15s. per short ton	189	50	45	8	4
Bonemeal ...	£15 14s. per short ton	188	20	18	20	12
Ground Lime- stone	£4 10s. per ton	54	0	0	40	0

(These foodstuffs are assumed to contain 10% moisture.)

Composition of Foodstuffs.

Having listed the percentages of digestible protein, calcium and phosphorus required by laying hens, it is now necessary to know the quantity of each of these ingredients in the foodstuffs available. In Table I the approximate composition of various West Australian foodstuffs is recorded, along with the cost ex store, Perth, in June, 1947. It should be stressed that the quality of foods vary considerably from place to place, and from year to year, and that the figures given in any Table of Composition can serve only as a guide. In Table I, for example, oat grain is listed as containing 7 per cent. digestible protein but this is only an average figure: samples may contain as much as 11 per cent. or as little as 5 per cent. digestible protein. This variability is emphasised because there is a tendency to place undue reliance on Tables of Analyses and theoretical rations calculated therefrom. The correct procedure is to use Tables to check what appears to be a sound practical ration and then do as all good stockmen have done, judge the value of a ration by the results obtained. It will be noted that the ration Tables have been prepared in terms of "digestible protein." This is because the protein value of a food is determined by the fraction which the animal can absorb and not by the total amount of crude protein which may be present. The distinction may not be important to poultry keepers as most of the foodstuffs fed to laying hens have a high digestibility but it is good practice always to consider feeding stuffs in terms of their actual food value, that is, in terms of digestible food constituents.

The various rations fed to the experimental birds at Muresk are listed in Table II and will be discussed in order.

TABLE II. (*Rations for Lying Hens*)—Nutritive value and Cost.

Ration.	Foodstuffs Required.	Weight lb.	Cost pence.	Nutrient Supplied.		
				Digestible Protein.	Calcium (Ca)	Phosphorus (P)
I.	Wheat	50	62.0	4.0	0.02	0.11
	Bran	30	27.9	3.0	0.02	0.18
	Pollard	10	9.3	1.0	0.01	0.03
	Meatmeal	10	18.9	4.5	0.80	0.40
	Ground Limestone	3	1.6	0.0	1.2	0.0
	Bonemeal	2	3.8	0.4	0.4	0.24
		105	123.5	12.9	2.45	0.96
		100	118	12.3%	2.3%	0.9%
II.	Wheat	30	37.2	2.4	0.01	0.06
	Crushed Oats	20	26.4	1.4	0.01	0.04
	Bran	30	27.9	3.0	0.02	0.18
	Pollard	10	9.3	1.0	0.01	0.03
	Meatmeal	10	18.9	4.5	0.80	0.40
	Ground Limestone	3	1.6	0.0	1.2	0.0
	Bonemeal	2	3.8	0.4	0.4	0.24
		105	125.1	12.7	2.45	0.95
		100	120	12.1%	2.3%	0.9%
III.	Wheat	50	62.0	4.0	0.02	0.11
	Crushed Oats	20	26.4	1.4	0.01	0.04
	Bran	10	9.3	1.0	0.01	0.06
	Pollard	10	9.3	1.0	0.01	0.03
	Meatmeal	10	18.9	4.5	0.80	0.40
	Ground Limestone	3	1.6	0.0	1.2	0.0
	Bonemeal	3	5.6	0.5	0.6	0.36
		106	133.1	12.4	2.65	1.00
		100	126	11.7%	2.5%	0.9%
IV.	Wheat	80	99.2	6.4	0.03	0.18
	Cr. Peas	10	20.0	1.8	0.01	0.04
	Meatmeal	10	18.9	4.5	0.80	0.4
	Ground Limestone	3	1.6	0.0	1.2	0.0
	Bonemeal	3	5.6	0.5	0.6	0.36
		106	145.3	13.2	2.64	0.98
		100	137	12.5%	2.3%	0.9%
V.	Wheat	90	111.6	7.2	0.04	0.20
	Meatmeal	10	18.9	4.5	0.80	0.40
	Ground Limestone	3	1.6	0.0	1.2	0.0
	Bonemeal	3	5.6	0.5	0.6	0.36
		106	137.7	12.2	2.64	0.96
		100	129	11.5%	2.3%	0.9%
VI.	Wheat	60	74.4	4.8	0.02	0.13
	Oats	30	39.6	2.1	0.02	0.07
	Meatmeal	10	18.9	4.5	0.80	0.4
	Ground Limestone	3	1.6	0.0	1.2	0.0
	Bonemeal	3	5.6	0.5	0.6	0.36
		106	140.1	11.9	2.64	0.96
		100	132	11.2%	2.3%	0.9%

Ration I (Control).

The control ration in the Muresk experiments was selected as being similar to that which would be used by choice by a large number of poultry farmers. It contains 50 per cent. whole wheat grain and 40 per cent. mill offal, and lends itself to a variety of feeding treatments. At Muresk all the ingredients are mixed together and fed dry in a large self-feeder but where the use of a wet mash is preferred, the bran, pollard, meatmeal and minerals could be fed as a wet mash in the morning and the grain at night. As can be seen from the Table this ration is well balanced in nutrients and the cost (in Perth) of about 10s. per 100 lb. is very reasonable. All groups receive a kerosene tin of chopped green stuff per 100 birds per day. It is to be expected that the hens receiving the Control Ration should produce well and remain in good health.

Ration II.

The control ration has two obvious disadvantages—it consists mainly of wheat or wheat products, and it contains 40 per cent. mill offal which at the present time is difficult to obtain. In Ration II an effort is being made to determine if a mixture of wheat and oat grain is of more value than wheat grain alone. Most livestock feeders maintain that a mixture of cereal grains will always give better results than one grain alone. Wheat, for example, may be lacking in some factors which would be supplied by oats, and vice versa. It will be interesting to see if the birds in the second group do show any significant difference in production from those in Group I. From the point of view of cost, Ration I is preferable to Ration II.

Ration III.

At present prices bran and pollard are the cheapest foods a poultry farmer can buy but unfortunately the demand greatly exceeds the supply. It follows that rations containing little or no mill offal must often be used. In Ration III crushed oats have been used to replace 20 lb. bran. It will be seen from the Table that this change decreases the theoretical nutritive value of the ration and increases the cost. In practice, however, good quality oat grain may give quite good results. It should ease the position for country egg producers if oats are found to be a satisfactory substitute for bran and pollard.

Ration IV.

Many practical men are of the opinion that a ration consisting mostly of cereal grain is greatly improved by the addition of relatively small amounts of leguminous seeds. At present such seeds cannot be purchased as stock food but it should be possible for many poultry producers in the country to grow crops such as field peas, tangier peas, or vetches. Vetches, for example, now being studied by State and Commonwealth officers, have been found to yield well over a ton of seed per acre when grown in our wheat belt, and as these hardy plants are resistant to red mite and the pea weevil it might become profitable to grow these protein-rich seeds for poultry. There is some doubt, regarding the value for fowls of the protein in leguminous seeds. For this reason field peas (the only leguminous seeds at present obtainable in quantity) are being tested at Muresk. The ration is quite uneconomic at present prices but should leguminous seeds become available in the future it may be helpful to know something about their feeding value for laying hens.

Ration V.

In Ration V simplicity has been taken to its uttermost limit. The birds receive only whole wheat grain, meatmeal and a mineral mixture. Labour costs have been reduced to a minimum by feeding the grain in one large self-feeder and the meatmeal and minerals in another. Much of the success of this ration will depend on the quality of the meatmeal and for this reason alone, the results will be of considerable interest. Where greenstuff is available, a simple ration such as this should give quite good returns.

Ration VI.

An attempt has been made in this ration to relieve the monotony of Ration V by the replacement of 20 per cent. of the wheat with the same weight of crushed oats. Here again the object is to determine if a mixed cereal ration is more productive than one cereal alone.

General.

It is instructive to note that rations containing only wheat grain, or wheat and oat grain, are definitely more expensive than rations containing bran and pollard. This is a reflection of the high price at present commanded by cereal grains.

The percentage of meatmeal has been kept constant at 10 per cent. in all rations. This has been done purposely, so that the value of the other ingredients could be more easily compared. It is realised that meatmeal is difficult to obtain but it is probable that by the time the Muresk experiments have been completed normal supplies of this basic poultry food will be available.

Summary.

The rations used in the Poultry Feeding Trial now being conducted at Muresk Agricultural College have been tabulated so as to show the relative cost and nutritive value. At current prices the Control Ration (No. I) containing 40 per cent. mill offal is the most economical. The reasons for investigating variations of this apparently satisfactory ration are discussed.

Fodder Conservation in the Kimberleys.

W. M. NUNN, Agricultural Adviser.

IT has long been common practice in the agricultural areas of Western Australia, for farmers to conserve fodder grown in winter and spring months for feeding to stock during the long dry summer.

Cereal crops and clover and grass pastures are cut with the reaper and binder, or the mower, and stacked or ensiled for future use and in this way the short growing period is made to provide nutritious fodder to meet the needs of stock the year round.

If left to mature and dry in the paddock, clover and grasses still provide feed for grazing stock, but much of their food value is lost. Analyses of many species have shown that feed value is high in the young green plant, particu-

larly with regard to protein and vitamin content, and that these important constituents deteriorate rapidly as the plant dries off, to be replaced by a high proportion of indigestible fibre. Progressive farmers are careful therefore to conserve adequate supplies of fodder cut at or about the flowering stage.

Correctly conserved either as hay or silage, these fodders retain their high feed value and are fed to stock to ensure adequate rations when paddock feed is inferior.

In the Kimberley and North-West divisions stock are run over very extensive areas, indeed. In the former, cattle predominate while the latter is devoted almost entirely to sheep, but in both divisions, the stock are grazed over tremendous areas of natural herbage, faring well in good seasons and poorly in bad.

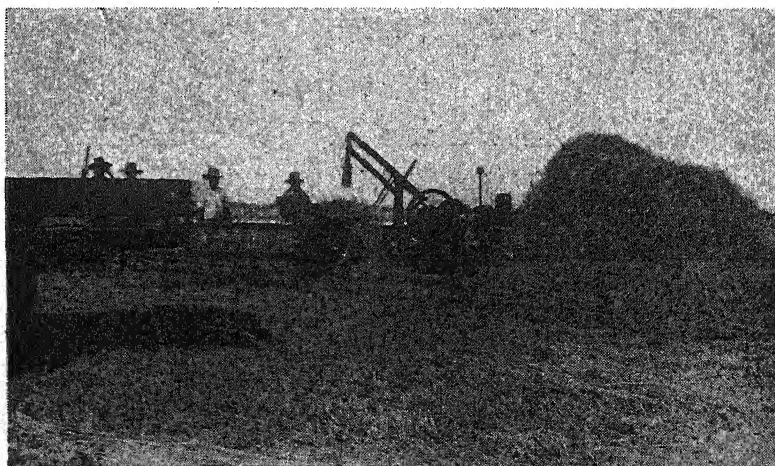
The North, like the South, has its wet period and its dry each year. The rains, however, occur in the summer and an extended dry period is experienced while the South is receiving its regular winter rains.

In the North-West division rains, even in summer months, are unreliable, and over extensive areas the principal stock feeds consist of shrubs or of spinifex rather than of grasses which would be capable of conservation. In the Kimberleys however, summer rains are reasonably assured, and a growth of natural grasses occurs during the wet of most seasons.

For many years several stations in the West Kimberley area cut grass hay each year and stacked it either in the paddock or at the homestead. Being loose it lost most of its feeding value when being handled and fed to stock.

In 1945 Liveringa station purchased a hay baler and undertook the mowing and baling of natural grasses, and Mr. K. C. Rose, the manager, has kindly supplied the following information concerning the extent of the work and the results achieved.

Liveringa is a sheep station of 700,000 acres with a 70-mile frontage to the Fitzroy River.



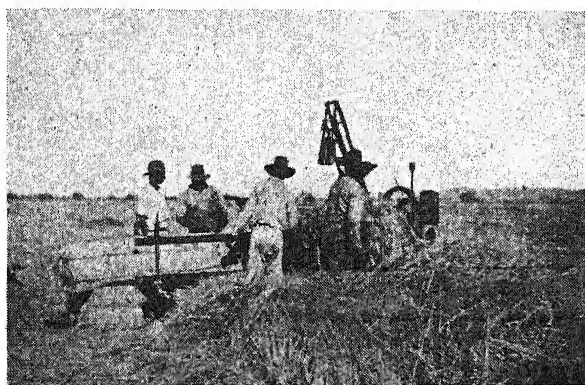
Hay is brought to the baler by truck-drawn sweep.

The extent of operations has so far been limited by the machinery available, but working within 3 miles of the homestead in March and April of this year, 3,200 bales were cut. Bales averaged 60-lbs. each and the yield was approximately $\frac{1}{2}$ -ton per acre.

Thus about 90 tons of high-grade fodder was obtained, and Mr. Rose considers that it will pay handsomely to extend operations on a much larger scale when more modern machinery can be obtained. He estimates that 20,000 bales could have been cut this year within 10 miles of the Liveringa homestead.

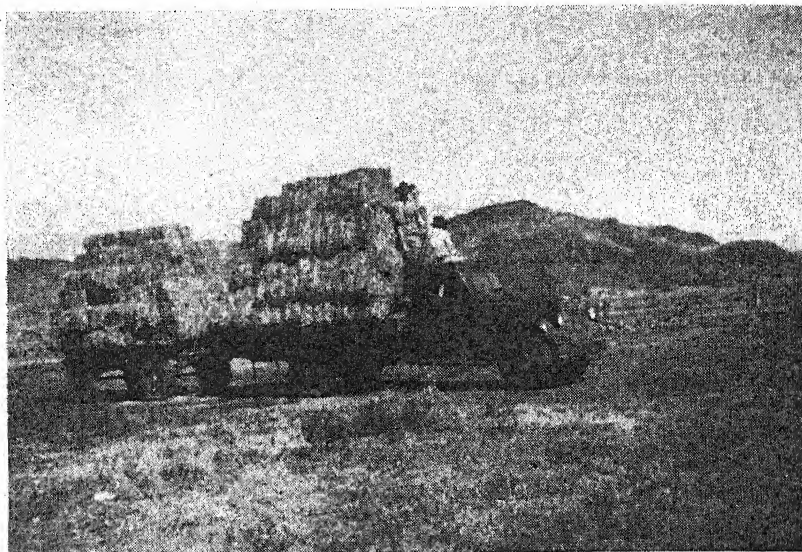
Two mowers and a rake are pulled by motor truck. The grass is brought to the hay baler by a sweep which is also pulled by truck. The grass is then fed to the baler by hand.

The fodder cut this year was mainly wheaten grass, but flinders, button, rice and bundle bundle grasses were present in admixture.



Two views of the baler in operation on Liveringa Station.

At Liveringa, portion of the grass hay is chaffed for feeding with oats to horses and mules. The rest is fed as long hay to rams during November and December prior to mating, and to horses on mustering camps.



Bales of 60 lbs. are easy to stack and convenient for handling and carting to feeding points.

These uses are restricted in comparison with hand feeding programs carried out on farms in the agricultural areas, but it is a distinct start towards the more economic use of locally grown fodders, and the Kimberley Pastoral Co. is to be congratulated on the initiative shown in this direction. That the example is already being followed by other pastoralists, is evidenced by the fact that two other stations in the district have this year purchased hay balers. Their progress, as well as further advances on Liveringa, will be watched with great interest by all concerned with Kimberley development.

Sodium Fluoride for the Treatment of Worms in Pigs.

C. R. Toop, Assistant Chief Veterinary Surgeon, Department of Agriculture.

In trials which were carried out in the United States in 1945 it was shown that sodium fluoride when administered in the feed was highly effective for the removal of large roundworms (*Ascaris lumbricoides*) from pigs.

Prior to that time a choice of two drugs, viz., oil of chenopodium and phenothiazine, had been available for this purpose. While the results obtained from the treatment with both of these drugs had been reasonably satisfactory, certain disadvantages had been associated with their use. At best the efficiency of these drugs did not usually exceed 60 per cent., leaving room for considerable improvement. Of the two, oil of chenopodium was the more reliable but suffered a disadvantage in that it was necessary to treat each animal individually, the drug being mixed with castor oil and administered as a drench by means of a sheep drenching gun or other suitable appliance. Treatment with phenothiazine was much easier since the drug could be given in the food and was readily consumed but on occasions

it proved unreliable removing only a small proportion of the worms harboured by the animals. Moreover, neither oil of chenopodium nor phenothiazine were effective against immature worms.

American publications which became available in 1945 indicated that sodium fluoride possessed a much higher degree of efficiency for the removal of roundworms than either of these drugs. In trials in which it had been administered in the ration at the rate of 1 per cent. for one day, it had succeeded in removing 97 per cent. of the large roundworms harboured by the treated animals. A note of caution was however, sounded. Since the drug possesses toxic properties it was emphasised that more extensive trials would be necessary before its use could be recommended.

Since this information became available sodium fluoride has been used in Australia with very satisfactory results. In this State trials on a limited scale have been carried out at the Muresk Agricultural College. Here its use has been confined to weaners in which a dosage of 5 grams (on sixth of an ounce) has been employed. In the case of individual animals in which it has been possible to check the results by post mortem examination enabling a count to be made of any worms remaining after treatment, the efficiency of the drug has always exceeded 90 per cent. and in more than half the treated animals it has reached 100 per cent.

Following upon the excellent results obtained from the treatment of single animals the treatment of all litters two to three weeks after weaning has been adopted as a routine practice. The drug is given thoroughly mixed in the ration (crushed wheat and meat-meal) at the rate of one ounce to every six pigs. In this dosage the mixture has been readily consumed and no ill effects other than occasional slight vomiting and the passage of soft faeces have occurred. In dealing with groups of pigs it has not been possible for economic reasons to check the efficiency of the treatment by post mortem examination but there is no reason to believe that it has not remained at a high level. In these experiments the drug has proved effective both against adult and immature worms.

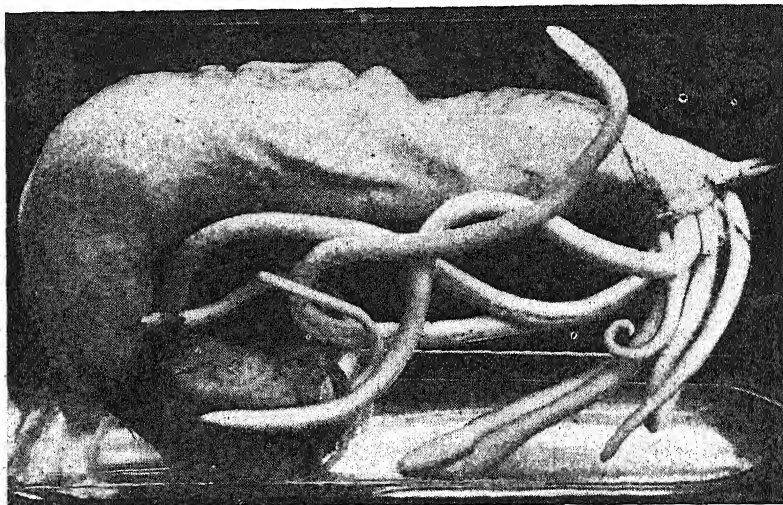
Recently a report of some comprehensive field trials with sodium fluoride carried out at the Animal Health Station, Yeerongpilly, Queensland, has become available. These trials, in which nearly 300 pigs of all weights were involved, including breeding sows and boars, have established beyond any doubt the safety and efficiency of the drug in the treatment of worms in pigs.

From the information gained from these trials a table of dosage has been prepared and is reproduced hereunder for the guidance of those who may contemplate using this method of treatment.

DOSE RATES.

Live Weight of Pigs.	Number of Pigs to 1 ounce of Sodium Fluoride.
lb.	
20	14
21—40	7
41—60	4
61—80	3
81—100	2½
101—150	2
151—200	1½
Over 200	1

Prior to treatment the pigs should be graded into small groups (up to 10 animals) of even size and the amount of sodium fluoride to be administered in their feed computed on a weight basis by reference to the above table. This should be weighed and thoroughly mixed in an amount of food which will be consumed during the course of the day. According to Queensland observations an allowance of 1 lb. of the treated food mixture per 25 lbs. live weight is adequate. On this basis seven weaners averaging 35 lbs. would receive 1 ounce of sodium fluoride in about 10 lbs. of food material. This amount will usually be consumed during the day but should any remain uneaten it should be mixed with the evening feed.



This is a portion of the small intestine of a pig tightly packed with large round worms (*Ascaris Lumbricoides*). Treatment with sodium fluoride would have removed most, if not all, of the parasites.

In our experiments at Muresk the drug was given in a mixture of crushed wheat and meat-meal which was fed dry and was readily consumed. Any other grain or meal mixture fed dry or if necessary moist, would be found equally satisfactory.

In the treatment of large pigs, sows and boars, the dose of sodium fluoride should be divided, half being given in the morning and the balance in the evening feed. In the case of such animals the food is rapidly consumed and the indigestion of a full dose of sodium fluoride in a short space of time may provoke violent vomiting. This does not, however, occur when the dose is divided. It is usual to starve the pigs overnight (allowing no food on the previous evening) prior to treatment but this procedure is probably unnecessary. Following treatment worms do not usually make their appearance in the droppings until three or four days and may continue to be passed out until the eighth or ninth day.

In the Queensland trials the efficiency of sodium fluoride in all cases exceeded 90 per cent. when single animals were treated. In the group trials the efficiency was somewhat lower but it was still very satisfactory and averaged 82 per cent.

When the drug was given in medicinal doses no ill effects resulted apart from the passage of soft faeces and mild vomiting in a few cases. Amongst the large number of pigs included in the trials no deaths resulting from the treatment were

recorded. The gradual consumption of the treated food apparently provides an adequate safeguard against the toxic effects of sodium fluoride and in addition should an excessive amount of the drug be consumed, vomiting is induced which provides a further safeguard.

The information now available indicates that sodium fluoride when given in the recommended dosage is a safe and highly effective drug for the treatment of worms in pigs and its use is consequently advocated.

Agricultural Problems.

Agriculturists, pastoralists and primary producers generally, who may be having difficulties of any kind in connection with their production activities, are invited to communicate with the Agricultural Adviser of their district of the Department of Agriculture, when information and advice will be supplied free of charge.

Where identification of plant or stock diseases or insect pests is required, full details of symptoms should be forwarded and also samples of the diseased plant, animal tissue or insect where practicable. Plant tissue intended for examination by the Plant Pathologist should be wrapped in paper and not forwarded in airtight containers, and plant specimens for the Botanist should be pressed between newspaper and dried before despatch. With regard to animal tissue for microscopic examination, this should be forwarded in a solution of 10 per cent. formalin, or if of considerable bulk in a sealed kerosene tin containing a few ounces of formalin as a preservative. Living insects should be sent in suitable containers and dead specimens in methylated spirits.

The addresses and names of Advisers are as follows:—

Albany	...	...	...	A. T. Gulvin, (Fruit)
Beverley	...	...	...	A. J. T. Marshall, (Court House)
Bridgetown	...	...	...	K. M. Simes, (Dairying): A. Flintoff, (Fruit)
Bunbury	...	...	...	N. R. McKeown
Busselton	...	...	...	A. L. Hamilton
Denmark	...	...	...	C. W. Tobin
Donnybrook	...	...	...	R. L. Cailles
Fremantle	...	...	...	N. Ingleton (Stock Office)
Geraldton	...	...	...	G. L. Throssell, (Government Buildings)
Gosnells, Kalumunda, Roleystone				W. P. Fears, (Kalamunda)
Kellerberrin	...	...	...	E. R. Watson, (Court House)
Manjimup	...	...	...	J. T. McNally, (Dairy): O. Hanbury, (Fruit)
Margaret River	...	...	...	V. B. Monti
Mundaring	...	...	...	V. Cahill

Routine Examination of Western Australian Butter for Micro-Biological and Chemical Content.

M. CULLITY—Superintendent of Dairying.

K. NEEDHAM—Officer-in-Charge, Dairy Laboratory.

Introduction.

SOME years ago biological examinations of Factory butters were carried out regularly by Griffen for a butter company in this State. Occasionally certain specific problems arising were investigated notably that on Rabbito by Cullity and Griffen (¹).

It has also been the practice to examine butter taken from the grading floor in Perth in connection with the annual competitions conducted by the Institute of Factory Managers and Secretaries.

In November, 1944, it was possible to institute a regular examination for both biological and chemical content in the Dairy Laboratory of this Department. Due to difficulties associated with the war years, the service could not be extended to cover factory equipment nor the processes of manufacture, and, therefore, analyses were confined to samples taken on the Perth grading floor. Recently, preliminary surveys have been performed at a metropolitan factory covering the various stages of processing and it is intended to extend this service to all Dairy Produce Factories in the State.

The Value of Biological Surveys.

While there is little, if any, correlation between the micro-biological counts of butter and its grade, there are certain specific organisms which are associated with definite flavours.

It is not possible to predict the grade of a butter from an assessment of its biological condition, but a factory whose equipment is clean, and whose butter contains consistently few organisms, will be found usually to have a record of high quality.

The visible cleanliness of the equipment, apart from good biological condition, is an indication of care frequently extended to the technical processes of manufacture which also have their effect on good quality.

The need for freedom from pathogens of any foodstuff is obvious. Grading of butter cannot be expected to be of value in detecting samples likely to be injurious to health, but routine bacteriological examination does assist in showing the presence or absence of organisms of the Coliform groups which include forms causing disease.

Examinations therefore serve as a means of ascertaining the general level of hygiene in the factory and to a very limited extent the possible presence of pathogens of the coliform type.

Surveys of the equipment in the factories are valuable in locating points of contamination which can then be remedied.

The Micro-Biological Examinations Performed.

The examinations performed include counts for Total Bacteria, Yeasts and Moulds, as well as observations for the presence or absence of Coliform organisms.

The Total Count gives a reliable guide to the total micro-biological population of the sample, and the result provides an indication of the general standard of cleanliness of the factory equipment.

It is generally accepted that the Yeasts and Moulds Count is a guide to the cleanliness of the churn and for this reason, it is included as a routine test.

Many of the bacteria belonging to the Coliform group are pathogenic to man, and therefore, by making an examination for this particular group, some indication is given of the possible presence or absence of human pathogens. Furthermore, the presence of Coliform organisms may indicate inefficient heat treatment, cooling, or re-contamination.

Method of Sampling and Performance of Examinations.

Since November, 1944, an endeavour has been made to sample butter from each of the ten factories in the State at approximately three weekly intervals, and this has been achieved with some measure of success.

Samples are taken on the grading floor in Perth from five consecutive churnings, in order to gain some idea of the consistency of the method of manufacture employed over a period of time. A core of butter, taken from the box, is divided into three, and placed into sterile bottles. The samples are delivered to the laboratory with the shortest possible delay, usually not more than two hours. The incubation period for the Total Count and Yeasts and Moulds is five days at 22°C. and for the tubes for Coliform organisms, two days at 37°C. Reports are forwarded to the factory manager and to the District Departmental Officer who are then in a position to co-operate in solving any problems.

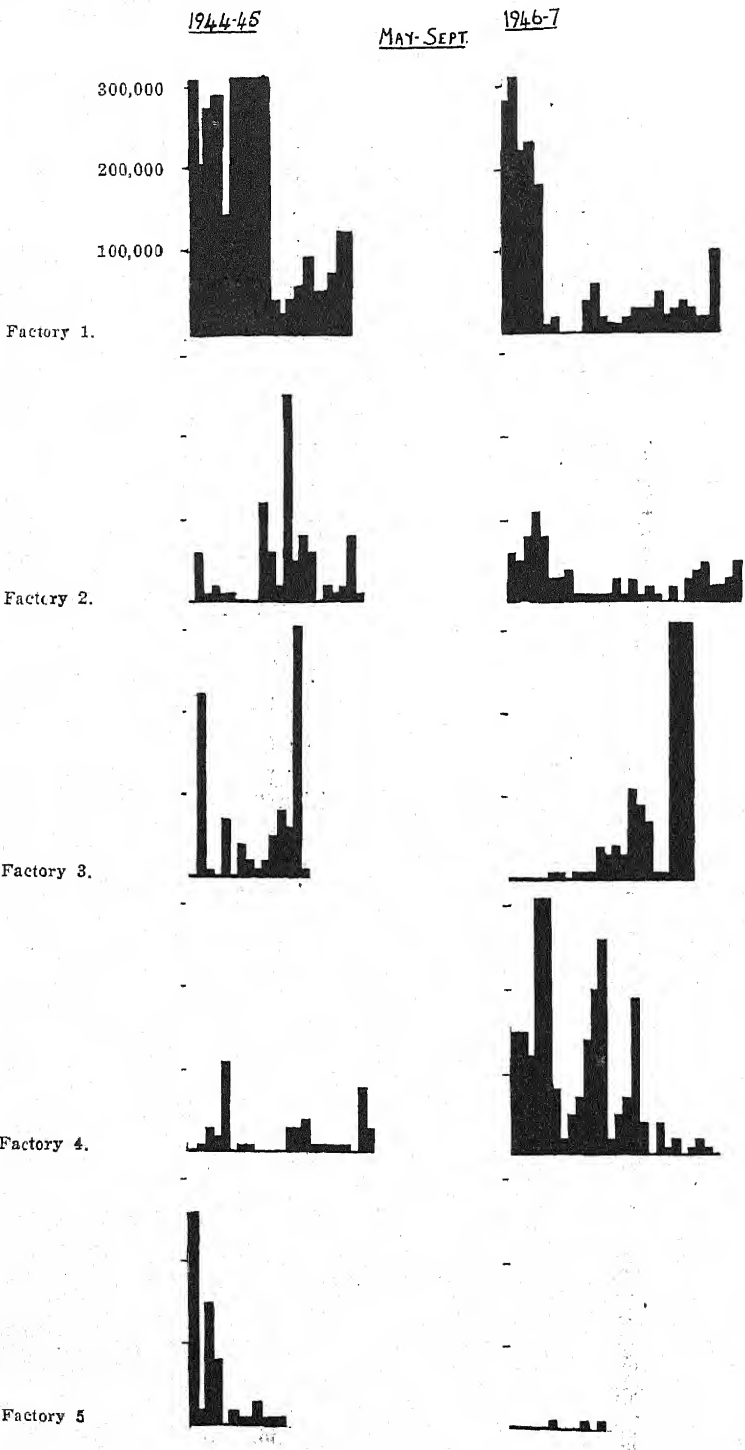
The basis of assessing the results is as follows:—

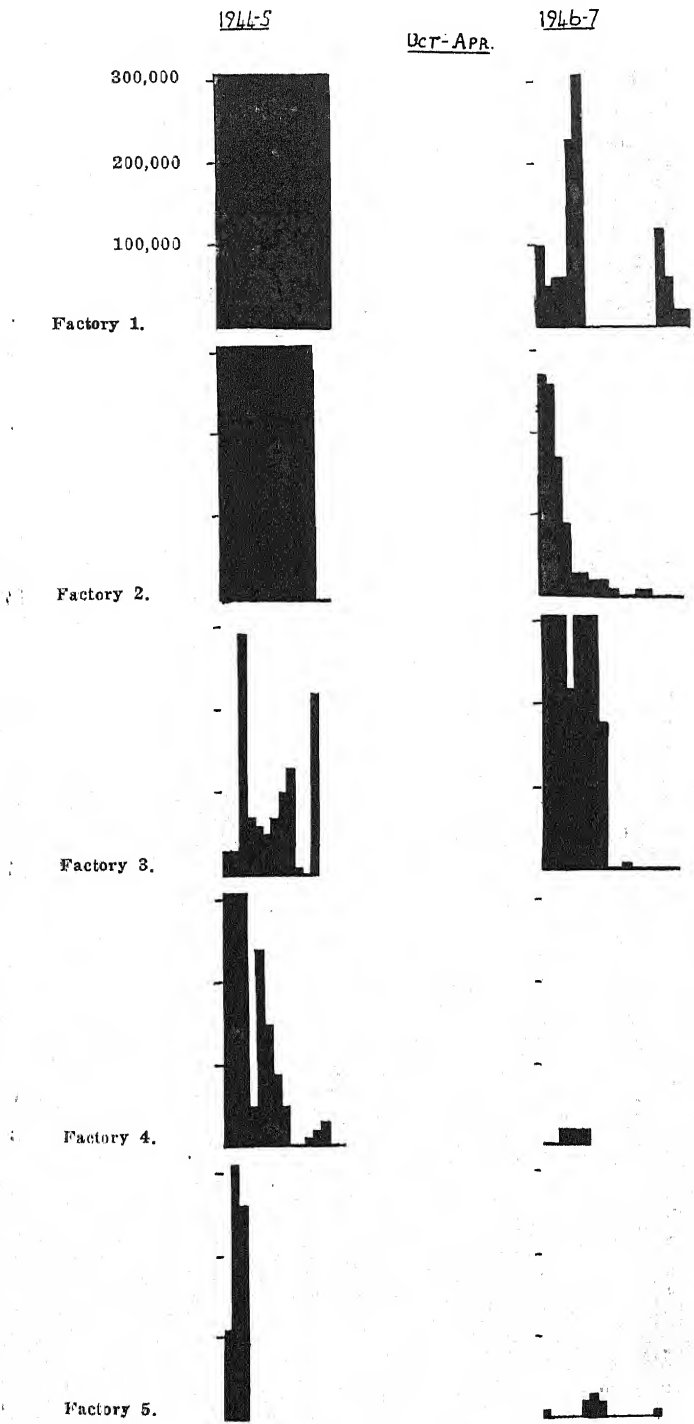
<i>Total Count.</i>		<i>Coliform.</i>		<i>Yeasts and Moulds.</i>	
Good ...	0—10,000	Negative ...	Satisfactory	Satisfactory ...	Below 50.
Fair ...	10—35,000	Positive ...	Unsatisfactory	Unsatisfactory ...	Over 50.
Poor ...	35—75,000				
Bad ...	Over 75,000				

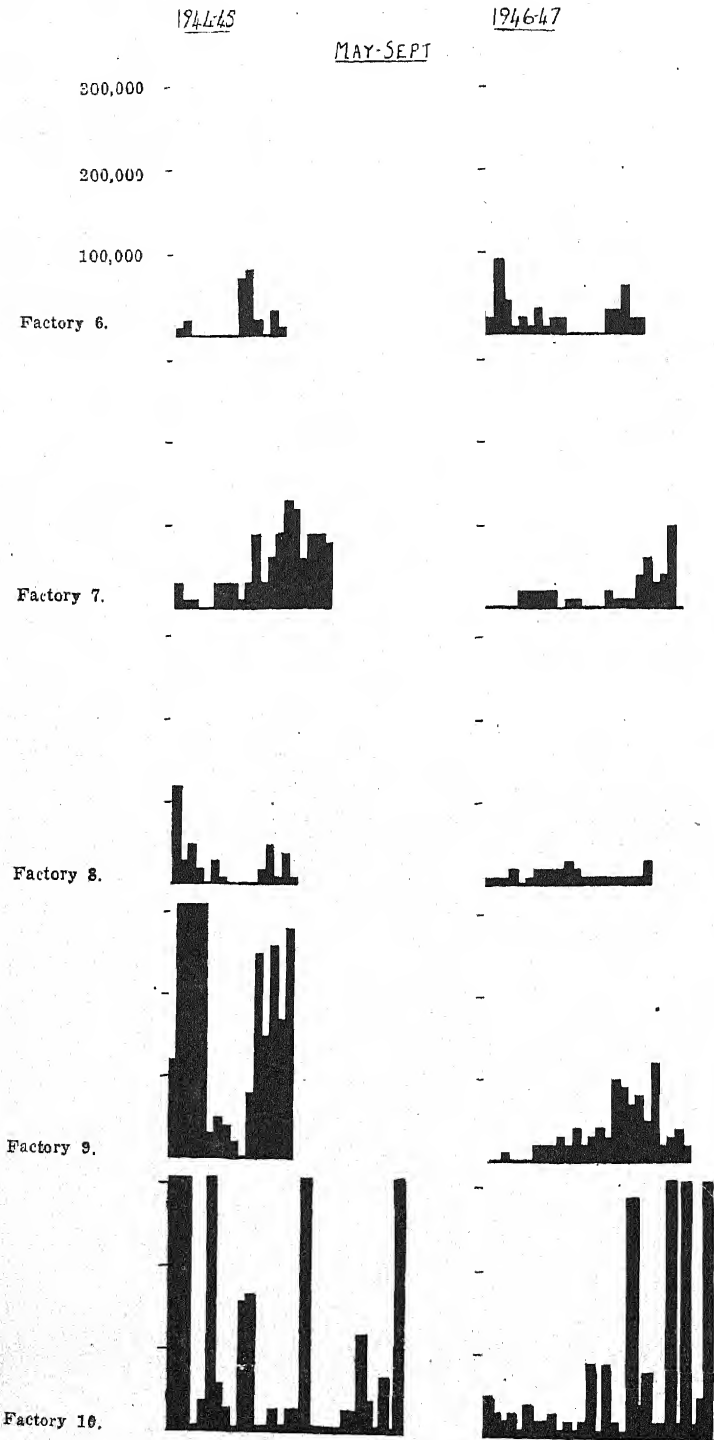
Total Counts.

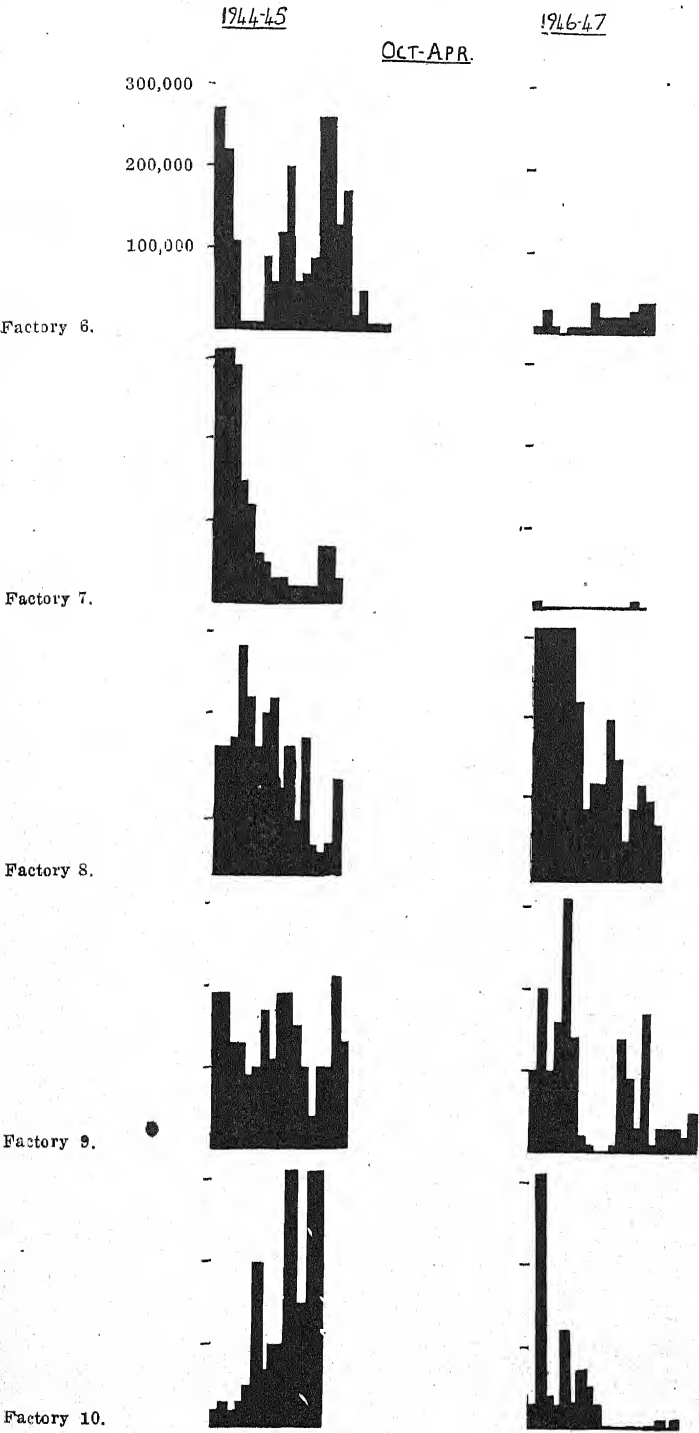
The following diagrams have been prepared to illustrate the general improvement which has taken place in most factories since the service was commenced. These diagrams, when read on the vertical axis, show the Total Count in terms of organisms per cc. and on the horizontal axis, the individual examinations made. The year has been divided into two parts corresponding roughly to the warm (October to April) and cool season (May to September). These groups for each year 1944-45 and 1946-47 are placed beside each other, so that by reading across the diagram it is possible to obtain a picture of the improvement or deterioration in the general bacterial condition of the factory under the same seasonal conditions.

It has not been possible to perform the same number of examinations for each factory and therefore, the tests do not correspond in point of time, but they do fall within the two main seasons into which the year has been divided.









Of the ten factories, six have improved considerably, (Nos. 1, 2, 3, 5, 6, 7) two slightly (Nos. 9 and 10) one slightly for the cool season, followed by deterioration in the warm months, (No. 8) while one has deteriorated (No. 4). This improvement, however, is not sufficient and there yet remains scope for considerable reduction in the bacterial count before a sufficiently high standard is reached.

The system of performing surveys of equipment in the factories will speedily improve quality, and permit of the immediate application of remedial measures.

It will be observed that many low counts were recorded in the warmer portion of the year despite the fact that atmospheric temperatures would be more favourable for the multiplication of bacteria. This may be due to the higher summer temperatures favouring the rapid drying of factory equipment after cleansing, and thus rendering moisture conditions not so suitable for bacterial growth. The degree of improvement in the short period under discussion is pleasing, but further work is needed before the position can be considered satisfactory.

Chemical Examinations.

Determinations of moisture, fat, salt, curd and serum p.H. are made to ensure that the consuming public receives an article equal to the prescribed chemical standard, and to assist the factories in their manufacturing technique.

The p.H. value is included because of its relationship to the keeping quality of butter during storage. Changes in butter may be attributed to two main causes:—

- (1) The activity of micro-organisms.
- (2) Chemical changes.

Micro-organisms require certain degrees of acidity or alkalinity to function at their optimum. Simply speaking, the p.H. value of the butter serum measures not the total acid or alkali, as is done with a titration, but the available acid or alkali at any particular time. It is this availability which determines the optimum conditions both for micro-organic and chemical changes. The p.H. is only one of several factors which will effect these changes. Temperature and the physical condition of the butter also play important parts, but the p.H. has been used successfully as an indication of the keeping quality of butter during storage(?).

Experimental data has shown that the optimum keeping quality range lies between 6.7 and 6.9, but values up to 7.2 are not harmful. When the p.H. rises above 7.2 or falls below 6.7, the keeping quality of the butter may be expected to be poor. Since the attainment of the desired p.H. depends on the efficiency of the neutralisation of the cream before churning, this process must be efficient. p.H. determinations therefore can be used to check the accuracy of the factory technique.

The following table gives the p.H. results obtained for the years 1944-45 and 1946-47, and which have been discussed above in relation to the bacterial content in terms of Total Count. The table has been divided to show the number and percentage of samples falling into ranges—less than p.H. 6.7, p.H. 6.7 to 6.9, p.H. 7.0 to 7.2, and values greater than 7.2 p.H. Values less than 6.7 and greater than 7.2 are undesirable. Although the range p.H. 6.7 to 7.2 is permissible, the narrower range of 6.7 to 6.9 is preferred.

p.H. OF BUTTER SERUM.

Factory.	Total Samples.	Year.	Less than 6.7		6.7—6.9		7.0—7.2		Greater than 7.2	
			No.	%	No.	%	No.	%	No.	%
1	43	1944-45	31	72.1	6	13.9	...	...	6	13.9
	49	1946-47	8	16.3	17	34.7	19	38.8	5	10.2
2	41	1944-45	11	26.8	11	26.8	15	36.6	4	9.8
	44	1946-47	3	6.8	34	77.3	7	15.9	...	...
3	39	1944-45	26	66.7	7	17.9	3	7.7	3	7.7
	42	1946-47	31	73.8	8	19.0	3	7.1	...	...
4	35	1944-45	8	22.9	17	48.5	10	28.6	...	...
	46	1946-47	17	37.0	15	32.6	7	15.2	7	15.2
5	32	1944-45	1	3.1	9	28.1	5	15.6	17	53.1
	25	1946-47	7	28.0	7	28.0	3	12.0	8	32.0
6	46	1944-45	...	...	15	32.6	18	39.1	13	28.3
	35	1946-47	4	11.4	13	37.1	16	45.7	2	5.7
7	56	1944-45	3	5.4	2	3.6	28	50.0	23	41.1
	40	1946-47	...	...	...	...	5	12.6	33	87.5
8	50	1944-45	10	20.0	14	28.0	20	40.0	6	12.0
	25	1946-47	7	28.0	16	64.0	2	8.0	...	...
9	50	1944-45	4	8.0	13	26.0	33	66.0	...	...
	45	1946-47	5	11.1	22	48.9	17	37.8	1	2.2
10	51	1944-45	8	15.7	20	39.2	16	31.4	7	13.7
	34	1946-47	1	2.9	14	41.2	13	38.2	6	17.6
All Factories	443	1944-45	102	23.0	114	25.7	143	33.4	79	17.8
	385	1946-47	83	21.6	146	37.9	92	23.9	64	16.6

The table shows that four of the factories have improved considerably (Nos. 1, 2, 8, 9), three moderately, (Nos. 3, 6, and 10), one has remained practically the same (No. 5) while two have deteriorated (Nos. 4 and 7). With respect to the optimum range of 6.7 to 6.9 when considering all factories it will be noted that there has been a moderate improvement from 25 per cent. to 37 per cent. within the most desirable range.

REFERENCES.

(1) Cullity and Griffen: "Rabbit and Surface Taint in Butter," *Journal of Department of Agriculture, W.A.*, Vol. 15, June, 1938, p. 137.

(2) Kretchmar: "The Relationship between the Hydrogen Ion Concentration, the Flavour, and the Keeping Quality of Butter," *Journal of Department of Agriculture, W.A.*, Vol. 15, September, 1938, p. 330.

“Yarloop” (White Seeded) Subterranean Clover (*Trifolium Subterranean*)

H. G. ELLIOTT Agrostologist.

C. A. GARDINER, Government Botanist.

IN Western Australia the name subterranean clover has been known for many years, and over that period many strains of this clover ranging from extra early to late maturing ones have been found. These strains grow successfully under varying soil and rainfall conditions in this State.

One of the most recent strains now commercialised, is that one known as “Yarloop” subterranean clover, which is also called “Albino,” or “White Seeded” subterranean clover. This clover as far as can be ascertained, originated in the vicinity of the Yarloop-Cookernup area of this State. During the past year much controversy has occurred as to where it actually originated and just where it was first discovered. Some growers claim that they have different strains of this type, but no serious attempt has been made, as yet, to determine these claims. However it is approximately eight years since it first came into prominence as a commercial clover.



Yarloop subterranean clover growing on the property of J. Woodier, Harvey West, 1941.

“Yarloop” subterranean clover is an early flowering, quick growing, pale green leaved, heavy bulk producing type, which grows under many and varying conditions in the medium and high rainfall areas of the South-West. This clover appears to prefer the water-logged, heavy clayey lands on the coastal plain, but will grow well on other soil types, including the winter wet light sandy ones.

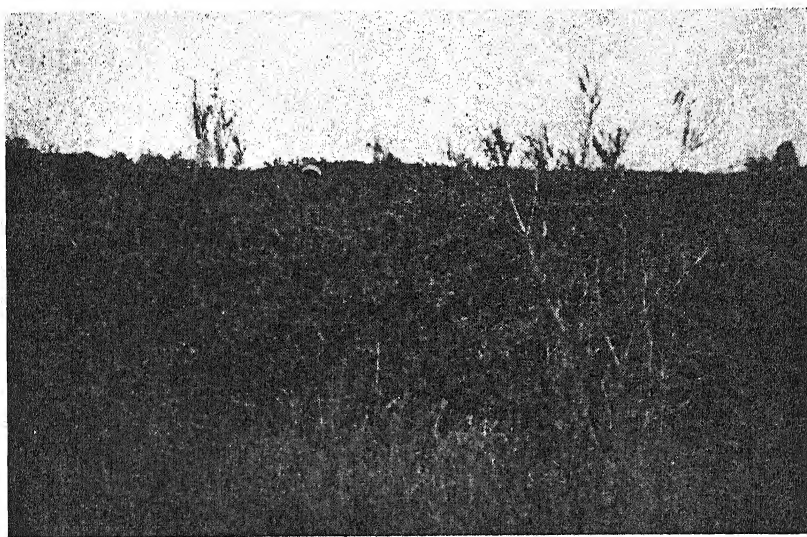
By far the most important development which has occurred in the South-West during the last eight years has been the progress and extension of this clover, as,

large areas of more or less useless winter-wet, heavy clayey land in the areas west of the railway line from Pinjarra to Brunswick have been brought into heavy production by the introduction of this clover in conjunction with superphosphate.

Description of Plant.

A prostrate annual plant of spreading habit, less clothed with silky hairs than the common strains of subterranean clover and paler in colour. Stipules broad, lanceolate, acute. Leaves on long stalks, the leaflets broadly obovate. Flowers two or three together on axillary peduncles, at first erect, lengthening considerably after flowering and turning down to the ground. The upper flowers of the head are barren, forming short whitish barbed processes, each with five spreading pointed teeth, and representing undeveloped calyces. When the peduncles curve downwards the fertile flowers turn back, and the inner barren flowers become outermost and surround the fertile flowers, protecting the maturing pods.

The flowering calyx is green; the tube is without hairs, many nerved in fruit and the lobes are long and narrow. The standard is twice as long as the calyx-lobes.



Yarloop subterranean clover growing on heavy clay country, West Harvey, 1941.

The pod contains only one seed, which, when ripe, is large and white in colour, and the most easily recognised of the subterranean clover strains. The burr contains from one to three seeds.

Seed and Strain—Prior to 1947 all seed purchased by intending growers of "Yarloop" subterranean clover was sold in the burr, and consequently it was difficult to detect impurities of other varieties. The burr was sold at varying prices from 12s. 6d. to £1 per bag, but there was no guarantee as to the actual weight of seed in a bag. The amount of seed in a bag could vary from less than 2 lbs. to 10 lbs. or more with a probable average of 3 to 4 lbs.

Early in 1947 the first cleaned seed was marketed at Harvey. This seed gives a reasonable guarantee as to trueness of strain owing to the creamy white colour of the seed, also the purchaser of cleaned seed now knows what quantity he can sow to obtain a reasonable stand. Up to 1947 and prior to clean seed being available, a farmer sowed from one to four bags of burr per acre to obtain a reasonable stand. It is anticipated that within the next twelve months practically all new sowings will be carried out by using clean seed sown at rates varying from 2 lbs. to 4 lbs. per acre.

At the present time "Yarloop" subterranean clover seed cannot be obtained as certified seed.

Where to Sow.

"Yarloop" subterranean clover appears to be able to adapt itself to a fairly wide range of soils and conditions. It is growing successfully in areas of 19 to 45 inches of winter type rainfall. This clover however, appears to be best suited to the heavy winter water-logged clayey soils but will grow well on a variety of soil types including the lighter sandy types which are winter wet. A good association plant under most conditions, is Wimmera rye grass.

Soil Preparation.

Very little in the way of soil preparation is necessary. Surface scarification of the land is all that is required. If possible the land should be harrowed after sowing operations are completed.

Competition.

On areas where drooping flowered clover (*T. cernium*) or Boyds clover (*Lotus hispidus*), flourishes, "Yarloop" subterranean clover will grow well, and providing no soil deficiencies such as copper or zinc occur, and it is adequately topdressed annually with superphosphate, it will compete successfully with the other plants and ultimately dominate the sward.

Inoculation.

It is essential when sowing clean seed on new land that the seed be inoculated with correct strain of nitro-fixing bacteria—these bacterial cultures can be obtained from this Department at a low cost.

Rate of Seeding.

At the present time with clean seed at 4s. 6d. lb. it is not recommended to sow more than 2 to 3 lbs. per acre, but the best rate of seeding to obtain a quick full stand in one year would be 4 to 6 lbs. per acre. When using burr the usual recommendation is to sow two bags per acre, but at the price of 15s. or more per bag it is very costly to establish an area by this means. Clean seed is more economical and free of weed and insect pests.

Fertilizer.

When establishing it is recommended to use at least 2 cwts. superphosphate per acre, this being applied in the autumn at the time of planting the seed. Subsequent annual applications of 1½ to 2 cwts. of super applied in the early autumn is recommended.

Management.

During the first year of establishment do not graze until after the winter is finished, and then only graze lightly to allow heavy seeding down. After drying down grazing can be carried out as the bulk of the burr will be buried. This clover will bury burr in the heaviest of clay and quite often to a depth of $\frac{1}{2}$ to 1 inch. In subsequent years if the land is of the heavy or clayey type, it is not recommended to graze in the winter months owing to the damage done by cattle to the land. Of all the subterranean clover strains this one is probably the best for production of early feed being far superior to other strains such as First Early "Dwalganup," Mid season "Mt. Barker," and the Late "Tallarook."

Palatability.

Experience shows that this clover is as palatable as the "Mid season" type both in the green and dry stages and although no chemical analysis have been carried out as yet evidence points to the fact that it appears equal to the other varieties in value.

Breeding For Non-Broodiness.

A. J. MILLINGTON—Geneticist.

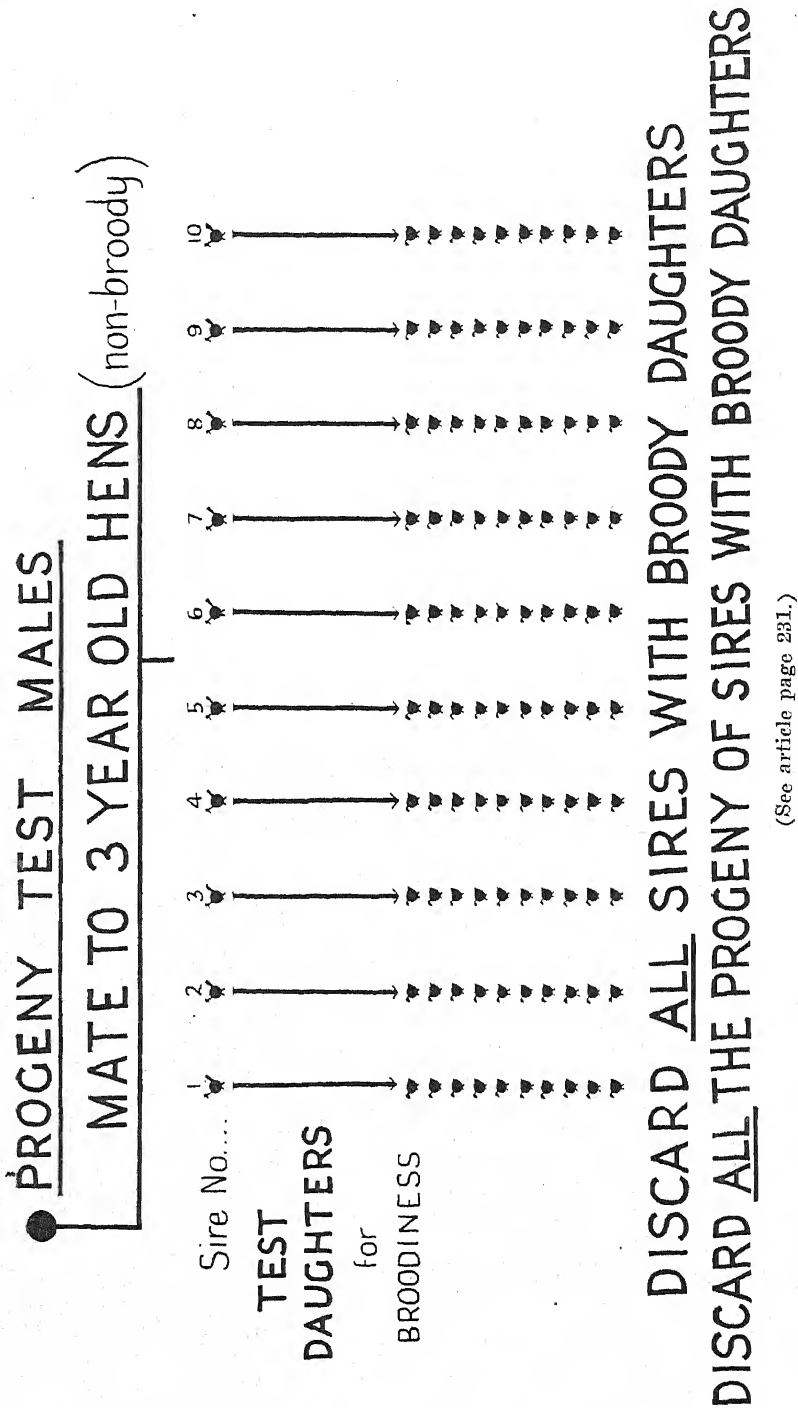
E. LOVEGROVE—Poultry Adviser.

BROODINESS is one of the first characteristics which the poultry-man seeks to eliminate in his constant search for higher egg production. The mode of inheritance of broodiness places it beyond the scope of ordinary mass selection as two non-broody lines or breeds may give progeny which are all broody. However, the inheritance or genetics of broodiness is fairly well understood and by careful selection and progeny testing it can be eliminated from the flock.

Three-year-old hens with an established record for non-broodiness are used for test mating young sires. About four or five hens will be required for each cockerel and both the male and female progeny of each mating should be retained. If all the female progeny of a particular male is non-broody in their first, second and third years it is fairly safe to assume that matings within the family so established will continue to be free of broodiness. The males can be mated with their half-sisters to establish a non-broody family but matings to other non-broody lines should be exploratory as two families between them may carry the heredity necessary for broodiness. Broodiness may be deferred until the second and third years so that data on the pullet year can be unreliable.

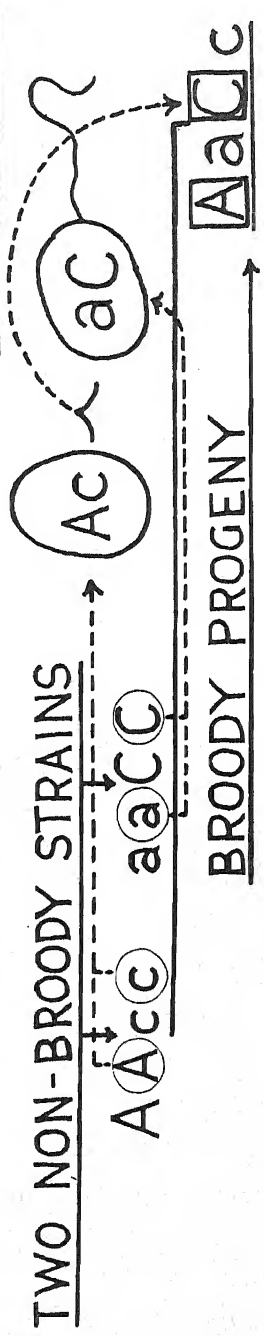
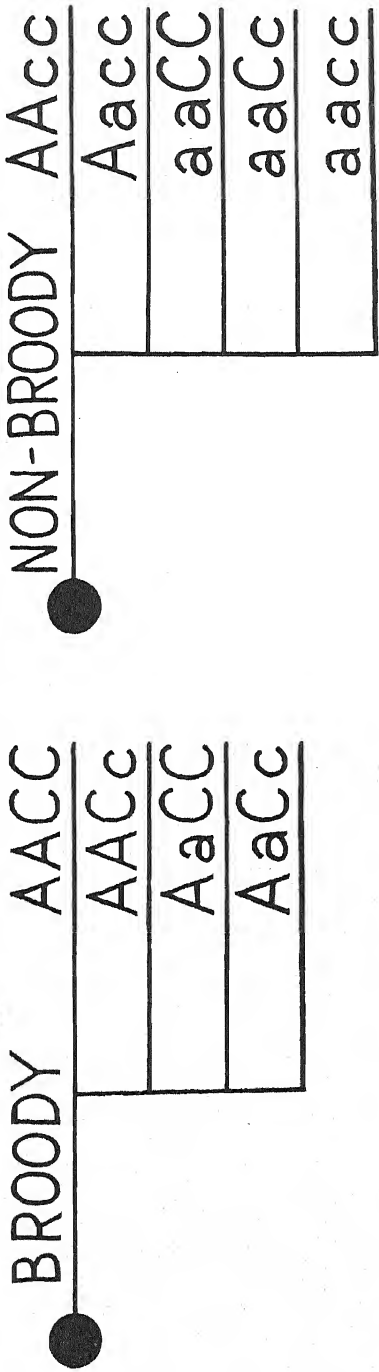
Genetics for Broodiness.

The accepted theory is that broodiness is dependent on the presence of two dominant genes A and C. Broody birds will have the genetic constitution AACC, AaCC, AACc or AaCc. Where only one or neither of the dominant genes is present, the birds will be non-broody and have the genetic constitution AAcc, Aacc, aaCC, aaCc or aacc. When "non-broody" breeds such as the Leghorns or Langshans are crossed they give broody progeny because one contributes the dominant gene A and the other C.



BROODINESS

CAUSED BY GENES A+C



(See article page 231.)

Perching.

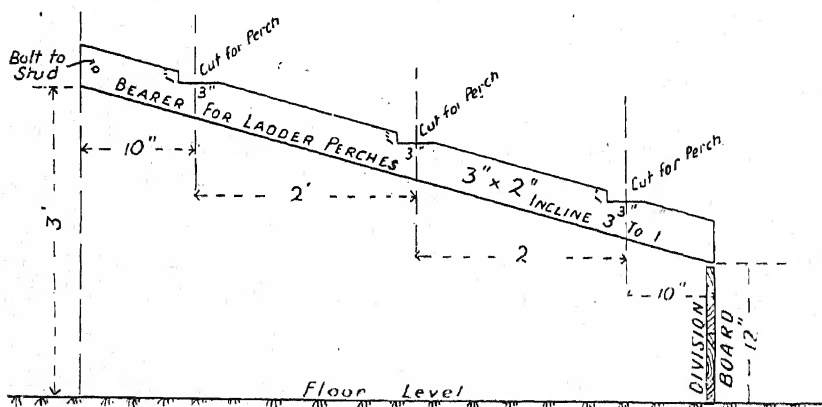
E. LOVEGROVE, Chief Poultry Adviser.

S. FROOME, Inspector.

SOME years ago the Department of Agriculture published a short article advocating the use of the ladder type of perching for poultry. Many poultry farmers have introduced this form of perching and they report most satisfactory results. It would appear that the advantages are:—

- (a) Owing to the fact that the heads of the birds are at least two feet apart and are at three different levels, there is a low incidence of colds.
- (b) Fresh air circulates freely between the perching birds and consequently assists to keep the stock healthy.
- (c) There is less danger of overcrowding.
- (d) Due to the incline of the perches, less floor space is required.

The accompanying sketch illustrates the design of the perches and it will be noted that the back is two feet higher than the front.



The perches are spaced as follows:—

Top perch—10 inches from the back wall and 3 feet above the floor.

Second perch—2 feet from the top perch and approximately 2 feet 2 inches above the floor.

Third perch—2 feet from the second perch and 15 inches above the floor.

The standard laying shed designed to contain 150 birds provides for the perches to be approximately 27 feet long. It is usual to construct three sets of perches, each set being three perches 9 feet long. The bearers supporting the perches are bolted to the studs in the back wall which allows the front of each set of perches to be raised and fastened to the roof to facilitate cleaning.

The commercial poultry farmer is faced with the problem of a fairly high concentration of birds and the consequent increase in the incidence of intestinal worms. Part of the life history of the common round worm of poultry is as follows:—

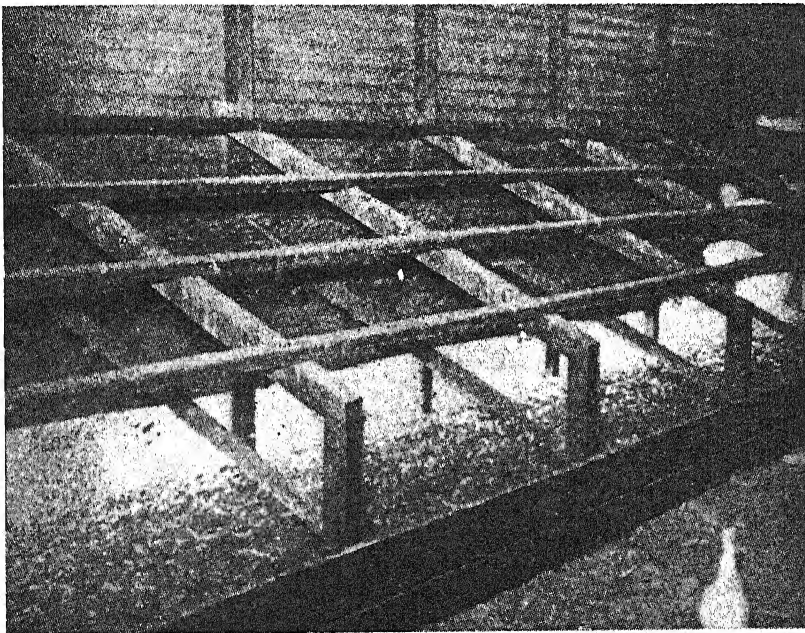
“After the eggs from the adult worms are passed in the droppings, they become infective for another bird in one or two weeks.”

Therefore, it is most important, particularly after a flock has been treated for worms, to prevent the birds being infected by the ingestion of worm eggs voided in the droppings.

With this object in view it is advisable to fasten 2 inch mesh wire netting to the underside of the perches to prevent the birds having access to the droppings on the floor below the perches.

The netting can be fastened to the bearers and will not prevent the perches being raised for cleaning, though in this case a division board would need to be placed along the front.

The illustration below shows the ladder types of perches in use on Mr Stocker's farm at Roleystone.



Wire netting of perches to prevent fowls gaining access to night droppings.

In this case the wire netting to prevent the fowls gaining access to the night droppings is fastened to battens about 10 inches below the perches; but is a permanent fixture. On this farm the droppings are cleaned away through the opening at the back of the shed and are then collected and disposed of.

Stock Foods.

The following Stock Foods have been registered at the Department of Agriculture under the Feeding Stuffs Act, 1928-46 for year commencing 1st July, 1947.

Stock Food.	Reg. No.	Brand.	By whom Registered.	Materials from which Made.	Registered Analysis.						
					Crude Protein.	Crude Fat.	Crude Fibre.	Sodium Chloride.	Phos. Acid (P ₂ O ₅).	Lime (CaO).	Other.
A.—SUPERFES FOODS.											
1.—Meat Meals.											
Meat Meal	22	J.K.S. No. 1	J. Kitchen & Sons Pty. Ltd.	Animal Fat and Bone	40.00	11.00	2.50	...	14.00	...	...
Do.	61	ANCHO	Anchorage Butchers, Ltd.	Waste meat products	50.56	15.88	1.48	0.56	9.39	11.24	...
Do.	120	SPEEDY	I. L. Taylor	Animal offal	28.00	14.00	5.00	0.50	15.00	21.00	...
Do.	135	STATE ABATTOIRS	State Abattoirs	Waste meat and offal	51.00	14.00	2.00	...	...	...	...
Meat and Bone Meal	100	TOIRS S.M.P.	W. R. and N. N. Clarke	Meat and bone	60.00	7.00	...	...	...	...	...
Do.	30	PENNELLIS	C. A. Kirkby & Sons	Meat and bone	50.00	12.00	4.00	...	...	...	...
Protein Meal	63	IMPERIAL (In Diamond)	W. Angliss & Co. (Aust.), Pty., Ltd.	Animal	50.00	12.00	2.00	...	...	...	...
Meat and Bone Meal	116	EXCELSIOR	Barrow Linton	Meat and bone	40.00	15.00	1.50	...	...	...	...
2.—Bone Meals.											
Bone Meal	62	ANCHO	Anchorage Butchers, Ltd.	Waste meat products	23.63	2.44	(Min.)	Trace	26.76	26.85	...
Bone Flour	1	TRICALOS	Pty. Gelatine (Aust.) Pty., Ltd.	Sterilised bone flour	5.00	...	...	...	32.50	40.00	...
Bone Meal	130	SPEEDY	J. L. Taylor	Animal bones	7.00	2.00	1.00	...	26.00	35.00	...
3.—Other.											
Lin Meal	126	WESTERN	David Gray & Co.	Linseed meal, yeast meal, bone meal, and minerals	25.00	5.00	7.00	...	...	CaCO ₃	...
Peanut Meal	3	ETA	Cruickshank Bros.	Peanut kernels	49.00	2.00	6.00	...	...	1.50	...
Milk Sugar Food	6	KRAFCO	Kraft Walker Cheese Co Pty., Ltd.	Whey from cheese manufacture	10.00	0.50	...	...	1.00	0.70	Lactose 68.00
Do.	7	LACTOCRRAFT	do.	do.	10.00	0.50	...	...	1.00	0.70	Riboflavin 25 u/gm.
Linseed Oil Meal	54	MLM	Megitt Ltd.	Linseed	30.00	4.00	10.00	...	...	...	25 u/gm.
Wheat Meal	73	WESTFARMERS	The Westradian Farmers Co-operative, Ltd.	Wheat	8.50	1.00	3.00	...	...	...	...
Roller Bran	79	do.	do.	do.	8.50	...	9.00	...	...	...	Trace
Protein Meal "A"	72	do.	do.	Meat meal, butter milk, meal, and minerals	35.00	8.00	4.00	2.00	...	8.00	...
Protein Meal "B"	73	do.	do.	Meat meal, liver meal*, bone meal, and minerals	35.00	7.00	4.50	...	...	15.00	...

[illegible]

Stock Food.	Reg. No.	Brand.	By whom Registered.	Materials from which Made.	Registered Analysis.									
					Crude Protein.	Crude Fat.	Crude Fibre.	Sodium Chloride.	Phos. Acid (P ₂ O ₅).	Lime (CaO).	Other.			
					% (Min.) 15-35	% (Max.) 7-50	% 1-50	% Less than 1-00	% ...	% Less than 2-00	% 1-50	% Ca 15-00	% Trace	% Trace
Calf Food	56	VETAMAC	A. H. McDonald & Co. ...	Wheat pollard, maize meal, linseed meal, milk sugar, nuttion bird oil	13-00	3-50	6-00	Less than 1-00	...	Less than 2-00	Trace			
Do. ...	65	WESFARMERS	The Westralian Farmers Co-operative Ltd.	Wheat meal, maize meal, barley meal, bran, buttermilk, whey powder, linseed meal, cal. carb. bone meal, salt mineral	20-00	4-00	9-00	...	...	1-50	Trace			
Do. ...	123	WESTERN	David Gray & Co. ...	Linseed meal, yeast meal, pollard, wheat germ, maize meal milk powder, lime, minerals	15-50	2-50	6-50	3-00	...	Ca 15-00				
Do. ...	131	THOMAS	W. Thomas & Co. (W.A.) Ltd.	Wheat meal, linseed meal, Sod. chlor., Calcium.										
3. Sheep Foods Sheep Food	25	EVE-LYN	Tropical Traders Ltd. ...	Linseed meal, linseed (whole), pollard, salt, limestone, chalk, animal charcoal, molasses, minerals, herbs.	9-81	5-95	14-79	5-82	4-34	10-15	Other 6-67			
Sheep Maintenance Cubes	66	WESFARMERS	The Westralian Farmers Co-operative Ltd.	Oat, wheat, barley, linseed, peanut and cocoanut meals, clover pollard, bone meal, molasses salt and minerals.	14-00	3-00	7-50	Less than 1-00	...	Less than 2-00	Trace			
Sheep Breeder Cubes Ewe & Lamb nuts	67 122	do. WESTERN	do. David Gray Co. ...	do. do. do. Linseed meal, yeast meal, bone meal, wheat germ, malt, minerals.	18-00 25-00	3-00 5-00	7-50 7-00	0-50 ...	...	2-00 1-50	Trace Trace Copper and Cobalt			
(4.) Poultry Foods Poultry Mash	4	K.B.	C. A. Kirkby & Sons ...	Wheat, milk, bone meal, bran, pollard, salt	13-00	3-45	7-00	0-26	1-21	0-10				
Laying Mash, No. 1	5	MILLERS	W. H. Milne & Co. ...	Bran, pollard, wheat meal, meat meal, bone meal, whey powder, salt	14-00	3-04	5-50	1-50	1-84	2-58				

		THOMAS	W. Thomas & Co. (W.A.), Ltd.		85.00	10.00	4.00	(Max.) 1.50		(Max.) 15.00		
34	Quick Lay	...	...	Dried yeast, meatmeal, blood-meal, liver meal, wheaten meal, Calcium, Sod. Chlor.	...	...	...	...	...	...	...	...
35	Quick Grow	Do.	do.	Meatmeal, blood meal, calcium, Sod. Chlor.	25.00	19.00	2.60	2.75	...	15.00	...	...
36	Special Laying Mash	Do.	do.	Bran, pollard, wheaten meal, Liver meal, calcium, sod. chlor.	13.50	3.00	7.50	1.50	...	3.75	...	...
37	Laying Mash No. 1	Do.	do.	Bran, pollard, wheat germ, pea meal, meat meal, dried yeast calcium, sod. chlor.	14.00	2.50	6.00	1.50	...	3.75	...	...
38	Do. No. 2	Do.	do.	Bran, pollard, wheaten meal, wheat germ, pea meal and/or meat meal*, calcium, sod. chlor.	11.00	2.50	6.50	1.50	...	3.75	...	...
40	Fattening Mash	do.	do.	Bran, pollard, wheat germ, wheaten meal, maize meal, pea meal, calcium, sodium chloride	10.00	2.00	6.50	1.50	...	3.75	...	...
68	Laying Mash No. 1	WESFARMERS	Westralian Farmers Co-operative, Ltd.	Wheatmeal, bran, oat meal, pollard, meat meal, whey powder, buttermilk, calcium carbonate, salt	14.00	4.00	7.00	0.50	...	CaCo 2.50	...	...
69	Laying Mash No. 2	do.	do.	Wheat meal, oat meal, pollard, bran, butter milk, whey powder, calcium carbonate, salt	11.00	3.00	7.00	0.50	...	2.50	...	...
70	Growers' Mash	do.	do.	Wheat meal, pollard, oat meal, bran, butter milk, meat meal, salt, calcium carbonate	13.00	4.00	7.50	0.50	...	2.00	...	...
71	Poultry Fattening Mash	do.	do.	Barley meal, wheat meal, pollard, oat meal, butter milk, calcium carbonate, salt	10.00	2.50	6.00	0.50	...	2.00	...	...
74	Laying Pellets No. 1	RED COMB	do.	Wheat meal, bran, oat meal, pollard, meat meal, whey powder, butter milk, calcium carbonate, salt	14.00	4.00	7.00	0.50	...	2.50	...	...
75	Do. No. 2	do.	do.	Wheat meal, oat meal, bran, pollard, butter milk, whey powder, calcium carbonate, salt	11.00	3.00	7.00	0.50	...	2.50	...	...
76	Poultry Fattening Pellets	do.	do.	Barley meal, wheat meal, pollard, oat meal, bran, butter milk, calcium carbonate, salt	10.00	2.50	6.00	0.50	...	2.00	...	...
77	Growers' Pellets	do.	do.	Wheat meal, pollard, oat meal, bran, butter milk, meat meal, salt, calcium carbonate	13.00	4.00	7.50	0.50	...	2.00	...	...
49	Poultry Pusher	PANNIFEX	F. W. Wright & Co.	Barley, oat meal, rice bran, wheat pollardings, pollard, rape seed meal, bran, maize meal, bolto refuse, blood meal, meat and bone meal	32.00	7.00	8.00	Trace	...	Trace	...	...

* Included when available.

Stock Food.	Reg. No.	Brand.	By whom Registered.	Materials from which Made.	Registered Analysis.						
					Crude Protein.	Crude Fat.	Crude Fibre.	Sodium Chloride.	Phos. Acid (P ₂ O ₅).	Lime (CaO).	Other.
					% (Min.)	% (Max.)	%	% (Max.)	%	% (Max.)	%
Egg Milk	39	THOMAS	W. Thomas & Co. (W.A.), Ltd.	Butter milk powder, milk powder, whey powder, water, meal, calcium salts, etc.	15.00	3.00	4.00	3.00	...	15.00	...
Laying Mash	101	MORLAY	R. B. Young	Bran, pollard, wheat meal, meat meal, ground limestone minerals	14.00	3.00	6.00	1.50	2.00	3.00	...
Laying Mash "B" ..	102	do.	do.	Bran, pollard, wheat meal, meat and bone meal, ground limestone minerals (linseed meal or cocoanut meal when available)	11.00	3.00	6.00	1.00	3.00	5.00	...
Laying All Mash	103	do.	do.	Bran, pollard, wheat meal, meat and bone meal, ground limestone minerals (linseed meal or cocoanut meal when available)	13.00	3.00	6.00	1.00	2.00	3.00	...
Growing Mash	104	do.	do.	Bran, pollard, wheat meal, meat meal, butter milk or whey powder, bone meal and minerals (linseed meal or cocoanut meal when available)	13.00	3.00	6.00	1.00	2.00	4.00	...
Growing All Mash	105	do.	do.	Bran, pollard, wheat meal, meat meal, butter milk or whey powder, bone meal and minerals (linseed meal or cocoanut meal when available)	13.00	3.00	6.00	1.00	2.00	4.00	...
D Mash (Fattening)	109	do.	do.	Bran, pollard, wheat meal, meat and bone meals, minerals	11.00	4.00	6.00	1.00	3.00	5.00	...
Laying Mash No. 2	110	EGGLAYER	Barrow Linton & Co.	Bran, pollard, oat, pollard, wheat meal, salt, limestone.	10.00	3.50	4.50	1.00	...	3.00	...
Laying Mash	111	do.	do.	Bran, pollard, oat pollard, wheat meal, meat meal, salt, limestone	14.00	3.50	4.50	1.00	...	3.00	...
Growing Mash	112	GROWEELL	do.	Bran, pollard, oat pollard, wheat meal, meat meal, salt, limestone, wheat germ	14.00	4.50	4.50	1.00	...	3.00	...
Fattening Mash	113	DUKKO	do.	Bran, pollard, wheat meal, bone meal, oat pollard, salt, ground limestone	10.00	4.00	4.00	1.00	...	3.00	...
Do.	119	WESTERN	David Gray & Co.	Milk meal, wheat meal, yeast meal, linseed meal, oat meal, salt, lime	11.00	3.00	5.00	0.50	...	1.50	...

Laying Mash "A"	120	do.	...	do.	...	...	12-00	3-00	7-00	0-50	...	1-50	...	...
							Mix of all, wheat meal, yeast meal, meat meal, liver meal, bone meal, lime, salt							
Laying Mash "B"	121	do.	...	do.	...	...	11-00	3-00	7-00	0-50	...	1-50	...	...
							Mix of all, wheat meal, yeast meal, linsed meal, bone meal, meat scrap, lime, salt							
Egg Food	124	do.	...	do.	...	...	40-00	6-00	4-00	...	...	1-50	...	...
							Meat meal, liver meal, bone meal, yeast meal, linsed meal, lime							
Pullet Food	125	do.	...	do.	...	...	30-00	6-00	4-00	...	...	1-50	...	...
							Meat meal, butter milk powder, linsed meal, bone meal, yeast meal, lime							
5.—Chick Foods. Chicken Mash	51	PATRIOT	...	J. & W. Bateman, Ltd.	...	...	15-80	4-20	4-30	...	...	...	...	...
							Pollard, bran, meat meal, oat meal, powdered milk, bone meal, maize meal, chick feed meal							Vitaminised Fish Oil Approx. 1-00 Mineral Trace
Chick Mash "A"	80	WESFARMERS	...	The Westralian Farmers Co-operative, Ltd.	...	...	15-00	4-00	7-00	Trace	...	1-00	...	...
							Wheat meal, pollard, bran, butter milk, meat meal, liver meal, maize meal, vitaminised fish oil, calcium carbonate, salt, manganese sulphate							Vitaminised Fish Oil Approx. 0-50
Chick Mash "B"	81	do.	...	do.	...	...	14-00	4-00	7-00	0-50	...	1-50	...	...
							Wheat meal, pollard, bran, maize meal, butter milk, meat meal, vitaminised fish oil, calcium carbonate, salt							Vitaminised Fish Oil Approx. 1-00 Mineral Trace
Chick Pellets "A"	82	RED COMB	...	do.	...	...	15-00	4-00	7-00	Trace	...	1-00	...	...
							Wheat meal, pollard, bran, powdered milk, meat meal, maize meal, vitaminised fish oil, calcium carbonate, salt, manganese sulphate							Vitaminised Fish Oil Approx. 0-50
Chick Pellets "B"	83	do.	...	do.	...	...	14-00	4-00	7-00	0-50	...	1-50	...	...
							Wheat meal, pollard, bran, maize meal, butter milk, meat meal, vitaminised fish oil, calcium carbonate, salt							Vitaminised Fish Oil Approx. 0-50
Chicken Milk No. 1	45	THOMAS	...	W. Thomas & Co. (W.A.), Ltd.	...	...	16-50	1-50	4-00	(Max.) 3-00	...	(Max.) 15-00	...	...
							Whey powder, meat meal, blood meal, bone meal, pollard, sodium chloride, calcium							

Stock Food.	Reg. No.	Brand.	By whom Registered.	Materials from which Made.	Registered Analysis.							Other.
					Crude Protein.	Crude Fat.	Crude Fibre.	Sodium Chloride.	Phos. Acid (P ₂ O ₅).	Lime (CaO).	%	
Chicken Milk No. 2	40	THOMAS	W. Thomas & Co. (W.A.) Ltd.	Whey powder, milk powder, bone meal, pollard, calcium, sodium chloride	% (Min.) 11.00	(Max.) 1.50	4.00	% 3.00	...	% 15.00	...	%
Chick Starter	41	do.	do.	Bran, pollard, wheaten meal, wheat germ, meat meal, milk powder, maize meal, pea meal, lucerne, pollard, dehydrated vegetables, cod liver oil, calcium, sodium chloride	14.50	2.50	6.00	(Max.) 1.25	...	Ca. 3.75	...	...
Chick Starter No. 2	42	do.	do.	Bran, pollard, wheaten meal, wheat germ, milk powder, whey powder, lucerne pollard, maize meal, calcium, sodium chloride	11.00	1.50	6.00	1.25	...	3.75	...	...
Chick Grower	43	do.	do.	Bran, pollard, wheat germ, meat meal, pea meal, milk powder, whey powder, maize meal, lucerne pollard, bone meal, calcium, sodium chloride	13.50	2.50	6.00	1.25	...	3.75	...	...
Chick Grower No. 2	44	do.	do.	Bran, pollard, wheat germ, meat meal, pea meal, milk powder, whey powder, maize meal, lucerne pollard, bone meal, calcium, sodium chloride	11.00	1.50	6.00	1.25	...	3.75	...	...
Chick Grain	47	do.	do.	Kibbled wheat, kibbled maize, kibbled peas, shell grit	9.00	1.50	4.50	...	...	...	...	...
Chick Starter	46	MILLERS	W. H. Milne & Co.	Bran, pollard, whey powder, oyster flour, bone meal, oat meal, cod liver oil, salt	15.06	4.34	6.10	1.09	1.84	3.11	...	...
Chick Food	52	PATRIOT	J. & W. Bateman, Ltd.	Cracked wheat, panicum seed, broken peas, broken maize, shell grit	11.80	3.00	3.80	...	...	...	...	...
Do.	53	HAYNES & CLEMENTS	Haynes & Clements	Wheat, maize, peas, kato corn, shell grit	9.00	1.50	4.50	...	CaO	3.00	...	...
Do.	60	ANCHOR	G. Wood, Son & Co., Ltd.	Wheat, bran, millet, blue peas, yellow peas, oyster grit, barley pollard, pea pollard, maize, milk	13.00	3.00	6.00	...	...	3.00	...	...
Chick Mash	106	MORLAY	R. B. Young	Bran, wheat meal, maize meal, meat meal, buttermilk or whey powder, bone meal, shellgrit, minerals.	15.00	3.00	6.00	1.00	2.00	5.00	...	...

Stock Food.	Reg. No.	Brand.	By whom Registered.	Materials from which Made.	Registered Analysis.						Other.
					Crude Protein.	Crude Fat.	Crude Fibre.	Sodium Chloride.	Phos. Acid (P ₂ O ₅).	Lime (CaO).	
					% (Min.)	% (Max.)	%	%	%	%	%
Dicalcic Phosphate	21	C.S.M.L.	Cuming, Smith and Mt. Lyell F.F. Ltd.	Calcium phosphate at least 90% of the P ₂ O ₅ being as dicalcic phosphate	...	...	...	...	37.00	28.00	Minerals. 11.05 4.75
Mineral Stock Food Medicated Lick ...	28 57	SYKE'S VETAMAC	Sykes (Aust.) Branch, Ltd. A. H. MacDonald & Co.	Sterilised bone flour and minerals Bone meal, molasses, whole meal, alces, minerals	...	...	...	70.00 53.00	5.60 5.70	4.4 7.5	...
Mineral Concentrate	58	VETSOLICK	do. do.	Pollard, bone meal & minerals	...	...	...	...	11.00	14.00	18.85
Coast Compound ...	59	VETAMAC	do. do.	Pollard, anised, molasses, minerals	...	...	...	...	...	...	32.88
Stock Lick ...	84	WESFARMERS	Westralian Farmers Co-operative, Ltd.	Bone meal and minerals	...	...	...	80.00	0.85	CaCO ₃ , 15.00	0.322
Dicalcic Lick ...	85	do.	do. do.	Salt, dicalcic phosphate	...	...	...	60.00	15.00	CaO	Ca 0.15
Denmark Lick Substitute	86	do.	do. do.	Limonite, salt, copper sulphate	...	...	...	65.00	...	...	F.E. 10.00
Lime Lick ...	87	do.	do. do.	Salt, cal. carbonate	...	...	...	35.00	...	CaCO ₃ 40.00	Minerals. 5.10
Cobaltised and Copperised Concentrated Sheep Lick "J"	88	VITA LICK	Goldsbrough, Mort & Co. Ltd.	Bone flour (degelatinised), bone charcoal, meals derived from the by-products of rice, cocoa and wheat and minerals	...	...	...	...	23.50	30.00	Max. Meals. 21.50
Cobaltised and Copperised Sheep Lick Mixed "J"	89	do.	do. do.	Bone flour (degelatinised), bone charcoal, meals derived from by-products of rice, cocoa and wheat, molasses, minerals	...	...	...	80.00	3.70	4.70	3.39
Cobaltised and Copperised Concentrated Sheep Lick "G"	90	do.	do. do.	Bone flour (degelatinised), bone charcoal, meals derived from by-products of rice, cocoa, wheat, minerals	...	...	...	...	23.50	31.00	12.70
Cobaltised and Copperised Sheep Lick Mixed "G"	91	do.	do. do.	Bone flour (degelatinised), bone charcoal, meals derived from by-products of rice, cocoa, and wheat, molasses, minerals	...	...	...	80.00	3.80	4.90	2.00
Cobaltised and Copperised Cattle Lick Concentrated "D"	92	do.	do. do.	Bone flour (degelatinised), bone charcoal, rice, cocoa and wheat	...	...	...	...	21.70	29.00	15.30

Cobaltised and Cop- perised Cattle Lick Concentrat- ed "G."	93	do.	...	do.	do.	do.	do.	...	25.00	32.50	10.20	5.85
Cobaltised and Cop- perised Cattle Lick Mixed "D."	94	do.	...	do.	do.	do.	do.	...	75.00	5.40	3.10	1.6168
Cobaltised and Cop- perised Cattle Lick Mixed "G."	95	do.	...	do.	do.	do.	do.	...	75.00	4.40	1.93	1.3968
Mineral Mixture ...	96	V.M.M.	...	do.	do.	do.	do.	...	4.30	9.50	60.20	4.47
Mineralised Blocks Chick-a-Vite ...	97 98	VITA LICK CHICK-A-VITE	...	do. do.	do. do.	do. do.	do. do.	...	Max. 76.00	Min. 9.50 27.60	...	0.72 10.30
Por-co-Vite ...	99	POR-CO-VITE	...	do.	do.	do.	do.	...	13.00	19.10	30.00	12.90

Bone flour (degelatinised), bone
charcoal, rice, cocoa and wheat
meals, minerals
Bone flour (degelatinised), bone
charcoal, rice, cocoa and wheat
meals, molasses, minerals
Bone flour (degelatinised), bone
charcoal, molasses, rice, cocoa
and wheat meals, minerals
Bone flour (degelatinised), bone
charcoal, meals derived from
rice and coconut, minerals
Minerals ...
Bone flour (degelatinised), bone
charcoal, cod liver oil, meals
from by-products of rice, gen-
tian minerals
Bone flour (degelatinised), bone
charcoal, cod liver oil, minerals

Fertilisers.

The following Fertilisers additional to those published in the December, 1946, Journal, have been registered at the Department of Agriculture, under the Fertiliser Act, 1928, for the year commencing 1st November, 1946.—

Name of Fertiliser.	Reg. No.	Brand.	By whom Registered.	Nitrogen (N) as					Phosphoric Acid (P ₂ O ₅) as					Potash K ₂ O.	
				Ni- trate.	Am- monia.	Blood & Bone	Bone- dust	Water sol.	Citrate sol.	Acid sol.	Total.	Sul- phate.	Muri- ate.		
3. POTASSIO. Sulphate of Potash	65	Chandler	State (W.A.) Alumite Industry	% ...	% ...	% ...	% ...	% ...	% ...	% ...	% ...	% 30.00	% ...		
5.—NITROGEN, PHOSPHORIC ACID AND POTASH Orchard Manure, No. 2. ...	69	Cresco	Cresco Fertilisers (W.A.) Ltd. ...	5.00	...	...	...	7.00	1.25	.75	9.00	5.00	...		
6.—SUPERPHOSPHATE AND COPPER Superacid Copper, No. 1 ...	66	Sickle	Cunning Smith & Mt. Lyell F.F., Ltd. &	...	...	...	...	14.00	2.50	1.50	18.00	Copper Sulph. 1.25	...		
B.—ORGANIC, Fish Fertiliser	68	Corno	Norwest Fertilisers ... ..	...	5.00	...	...	...	...	6.50	8.00	...	...
Garden Fertiliser	67	Superhumus No. 2	W. Austin ... ..	...	4.00	...	...	3.00	...	...	10.00	...	...
The registration of the undermentioned Fertiliser published in the December, 1946 Journal has been amended and now reads.															
5.—NITROGEN PHOSPHORIC ACID AND POTASH Tobacco Fertiliser No. 5 ...	26	C.S.M.L. ...	Cunning Smith & Mt. Lyell F.F., Ltd.	3.3	...	...	...	9.00	1.50	1.00	11.50	5.70	...		

Book Review

Bulletin 38: Imperial Bureau of Pastures and Field Crops.

ADVANCES IN GRASSLAND HUSBANDRY AND FODDER PRODUCTION SECOND SYMPOSIUM.

This bulletin is a second symposium on "Advances in Grassland Husbandry and Fodder Production." Bulletin 32 was the first. The two bulletins are akin to the earlier "Herbage Reviews" series.

The bulletin opens with four articles and the remainder of the "symposium" is a series of summaries, in some instances lengthy, of eleven papers and reports of diverse origin and objective.

The first article on objectives in veld investigations in Southern Rhodesia by West and Rattray gives an excellent appreciation of the problems of veld management and the techniques to be used in the investigations. The similarity of environment to coastal and sub-coastal Queensland gives added interest to the Australian reader. A short article on the economics of ley farming by A. W. Ashby follows. This is mainly of local interest. Professor Travin's discussion on "Formation of Plant Species" is an aspect of geo-botany which is not commonly included in an agricultural botany publication. Travin deduces a correlation between the process of species formation and seismic and volcanic activity and associates new species formation with regions of young geo-synclines. The statistical data presented are not particularly convincing. The fourth article is on "Forage Production in Switzerland"—a translation by Miss Roseveare from the German by Alfred Kauter. This article traces the intensification of cropping and sown pastures for a period of 10 years including the war period, largely because of the urgency of increasing home food production. The methods adopted included intensive extension work and some measure of compulsory ploughing and cropping.

The summaries of papers follow and include two of Australian origin, Schofield's study of coastal pastures at South Johnstone, Queensland, and Andrews' report on "Pasture Investigations in Victoria during 1944-45." The other nine summaries are:

- A Scottish Method of Grassland Improvement.
- Agricultural Seed Production as a New Industry in Welsh Farming.
- Grassland Research and Advisory Work in Sweden.
- Birdsfoot Trefoil as a Forage Legume.
- Hay Dehydration in the South-Western United States.
- U.S. Regional Pasture Research Laboratory.
- Weeds in Figs.
- Pastures and Fodder Plants in Sierra Leone.
- Land Resources of Tripolitania.

The subjects of this bulletin are both interesting and valuable but it is scarcely a symposium: rather is it a review.

*(Reviewed by J. Griffiths Davies,
Principal Agrostologist,
C.S.I.R. Division of Plant Industry).*

Note.—Copies of the publication can be obtained at a cost of three shillings (Sterling) from the Imperial Agricultural Bureau, Central Sales Branch, Agricultural Research Building, Penglais, Aberystwyth, Wales.

ERRATA.

VOL. XXIV., No. 2, JUNE, 1947.

Page 79: For "Vol. 24 (Second Series) June, 1947, No. 1" read "Vol. 24 (Second Series) June, 1947, No. 2."

Page 84: Second paragraph, "Windbreaks" line two, second last word for "Contracting" substitute "counteracting."

Page 108: Fig. 15B for "Clover crop" substitute "Covercrop."

Page 109: Fig. 15C for "Clover crop" substitute "Covercrop."

Page 115: Line 4, first word for "friut" read "fruit."



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No. 4

FURTHER STUDIES WITH CEREAL HAYS IN W.A.

By

E. J. UNDERWOOD* AND A. J. MILLINGTON.†

During the last two decades, there has been a steady decrease in the amounts of cereal hay conserved in W.A. Over the same period, there has been a marked decline in the numbers of horses and a marked increase in the numbers of sheep maintained in the agricultural areas. The position for the years 1929-46 is shown graphically in Figure I., using figures taken from the Statistical Register.

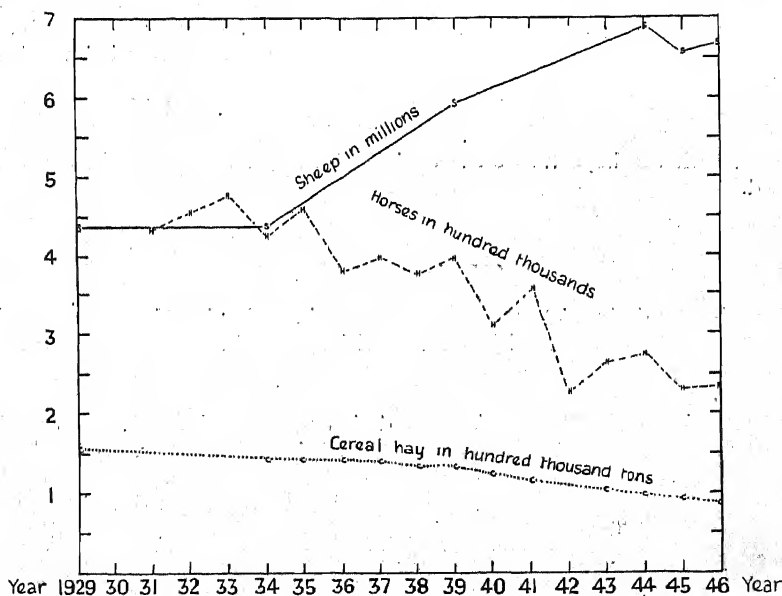


Fig. I.

These changes are of great significance in any considerations of fodder conservation practices. Sheep, unlike horses, are seldom housed and normally have access to ample "roughage" of varying quality in the paddock. Only in excep-

* Institute of Agriculture, University of W.A., Nedlands.

† Dept. of Agriculture, Perth, W.A.

tionally dry years or unusually prolonged dry summers will there be insufficient roughage for their needs. The most desirable addition to their diet during the summer months is, therefore, a concentrate. The cheapest and most readily available concentrates for this purpose are the cereal grains. Moreover, these grains are relatively good sources of digestible protein, besides being "energy" concentrates. Digestible protein is seriously lacking in most wheat-belt summer grazings.

Cereal hays, on the other hand, are exceedingly poor sources of digestible protein when cut at the stage of maximum yield of digestible dry matter or later. This fact was stressed by Underwood and Moir (1944), who found that wheaten and oaten hay cut at this stage contained insufficient digestible protein to supply even the maintenance requirements of adult sheep consuming the hay to the limit of appetite. If rapid wool growth is to be maintained, the protein intake of sheep must be considerably higher than the level for maintenance (Stewart and Moir, 1942).

These facts raise a number of very important questions concerning the relative value to the farmer of conservation of hay or grain, particularly in terms of yields of available nutrients per acre. Added significance is given by the high degree of mechanisation in the conservation of bulky fodders now possible, following the recent development of new and highly effective machinery for this purpose. This machinery is expensive and it is obviously essential, therefore, that conservation practices should be evolved which will use it to maximum advantage.

It is an unfortunate fact that, in spite of a considerable volume of Australian literature, extolling the virtues of fodder conservation, little or no experimental data are available on these important matters. Nor is there any information on curing losses with cereal hays and the factors which influence these losses, apart from the single experiment of the authors (Underwood and Millington, 1944). Experiments were therefore carried out at the Merredin Research Station in 1944 and 1945, with the hope that some useful information on these points would be obtained.

CURING LOSSES.

Experiments designed to measure the losses in curing hay for varying periods in the stook were conducted at Merredin with Mulga oats in 1944 and Charter Wheat in 1945.

In each instance, the experimental design was superimposed on a uniform crop grown on fallow and planted with normal farm machinery. A randomised block layout with four treatments and six replications was used. The whole of the plots were cut with the binder on the same day at the optimum time for hay (two to three weeks after full bloom, in this district) in both 1944 and 1945, and stooked in the normal manner. The yield of dry matter from each plot at the time of cutting, was obtained by calculation from the weight of green material and the dry matter content determined from samples transferred to the laboratory. At varying periods after cutting, the cured hay from a set of plots was weighed, chaffed and sampled for dry matter determination. From this data, the losses of dry matter which occurred during the different curing periods were obtained.

In Table I., the results are presented as percentage losses of dry material. Each figure in the table is the mean of six separate determinations.

TABLE I.
PERCENTAGE LOSSES OF DRY MATTER IN CURING CEREAL HAY.

Year.	Period of Curing (from the Time of Cutting).			
	3 weeks.	7 weeks.	11 weeks.	15 weeks.
1944 (Oats)	$\frac{\%}{4.2}$	$\frac{\%}{6.0}$	$\frac{\%}{6.0}$	$\frac{\%}{7.6}$
1945 (Wheat)	0.4	1.0	2.1	4.2

It is apparent from Table I., that the losses of dry matter in curing oats and wheaten hay under the conditions of 1944 and 1945 at Merredin, were exceedingly small. In fact, only in the case of the oats hay remaining in the stooks for four months were the losses statistically significant. This is very different from the results obtained by the authors with wheaten hay at Avondale Research Station in 1941, when an average loss in curing of 18 per cent. occurred and is in marked contrast to the large losses mentioned by overseas workers. Thus Watson (1939), gives the average losses in making meadow hay, without special appliances, as 22 per cent. for dry matter, 44 per cent. for starch equivalent, and 34.6 per cent. for digestible crude protein.

The absence of significant losses of dry matter in the Merredin experiments, was probably due to the very favourable conditions for rapid curing and the absence of any heavy falls of rain during the curing periods. In the 1941 experiment at Avondale, a number of falls of rain occurred, while the hay was curing. The relevant rainfall data are given in Table II.

TABLE II.
RAINFALL DURING CURING PERIODS.

Station.	Year.	September.		October.		November.		December.		January.	
		No. of wet days.	Points of rain.	No. of wet days.	Points of rain.	No. of wet days.	Points of rain.	No. of wet days.	Points of rain.	No. of wet days.	Points of rain.
Avondale ...	1941	*6	*87	4	27	5	35	3	20	...	...
Merredin ...	1944	...	...	†1	†6	...	...	2	24	...	...
Merredin ...	1945	...	...	‡3	‡8	4	7	3	26	1	2

* From date of *first* hay cutting on 10th September, 1941.

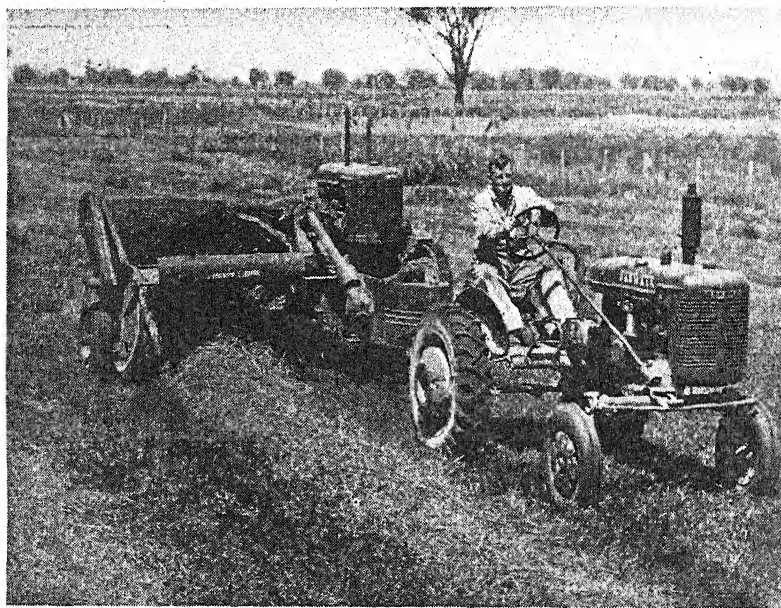
† From date of

hay cutting on 9th October, 1944.

‡ From date of hay cutting on 18th October, 1945.

Losses of total dry matter are obviously not the only consideration in the curing of hay. The possibility of a differential effect on particular nutrients could not be ignored, especially in view of the claim of Watson (*loc. cit.*), that the losses of available energy (Starch Equivalent) and digestible protein are much heavier than those of total dry matter, in the making of meadow hay under European conditions. This claim is supported by Axelsson (1941) in an analysis of Swiss, English, and Danish data. The chemical composition of the hay as cut, and of the cured hay after the different periods of curing, was therefore obtained for the 1944 experi-

ment. The mean results are presented in Table III. The figures for the hay as cut represent the average of individual samples from the whole 24 plots. The figures for the remaining treatments are from six plots in each case.



One-man automatic self-tying pickup baler.

TABLE III.

COMPOSITION OF OATEN HAY UNDER DIFFERENT CONDITIONS OF CURING.*

Percentage on dry basis.

Treatment.	Crude Protein.	Crude Fibre.	N-free Extractives.	Ether Extract.	Total Ash.	Calcium Ca.	Phosphorus (P).
As cut	4.7	28.6	58.3	2.5	6.0	0.07	0.13
Cured 3 weeks ...	5.2	28.5	57.5	2.6	6.2	0.08	0.13
Cured 7 weeks ...	5.1	29.7	56.3	2.4	6.5	0.08	0.13
Cured 11 weeks ...	5.5	29.3	56.4	2.6	6.2	0.08	0.13
Cured 15 weeks ...	5.7	30.5	54.7	2.5	6.6	0.08	0.14

* We are indebted to officers of the W.A. Government Chemical Laboratory for these analyses.

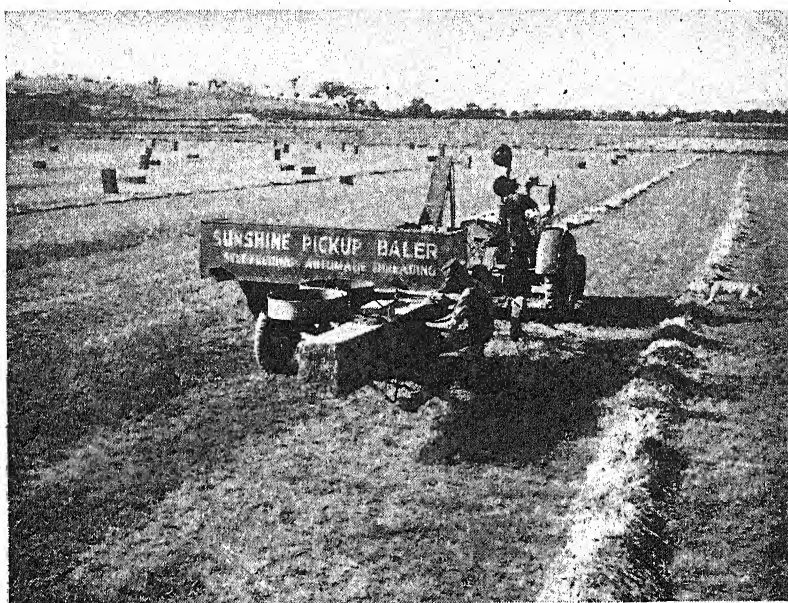
The data in Table III. shows clearly that no marked changes in composition occurred during the curing process. Only in the case of hay remaining in the stook for four months were the changes statistically significant. Under these conditions there was a *fall* in the N-free extractives fraction, the most digestible portion of the hay, of only 3.6 per cent., accompanied by corresponding *rises* in crude fibre, crude protein and total ash of 2.0 per cent., 1.0 per cent. and 0.6 per cent. respectively. Although these changes are significant, they are extremely small and of negligible effect on the nutritive value of the hay. No digestibility determinations

were made but it is inconceivable that, with such small changes in composition, there were any serious losses in digestibility during curing. If Axelsson's (1943) claim, that every one per cent. increase in fibre reduces the overall digestibility co-efficient by 0.93 per cent., be taken, it will be seen that even the hay cured for four months is less than two per cent. lower in digestibility than the hay when first cut. The digestibility of the crude protein would actually be *higher* after curing for this period, in view of the relation of co-efficients of apparent digestibility for this constituent to total protein intake.

No chemical analyses of the wheaten hays from the 1945 experiment were undertaken in view of the negligible losses of total dry matter and the negative results obtained from the previous years work.

RELATIVE YIELDS OF HAY AND GRAIN.

An attempt was made at the Merredin Research Station in 1945, to measure the relative yields, in terms of total dry matter and digestible nutrients per acre, of grain and of oaten and wheaten hay cut at the flowering stage, at the "late-milk" to "early-dough" stages (two to three weeks after flowering) and when matured.



Baling meadow hay direct from the windrows.

A split plot design, involving three plots replicated six times, was used. A plot comprised one width of a 15-run disc drill, with the centre tube blocked, 10 chains long. Bungulla wheat was sown from one half of the drill and Ballidu oats from the other half. These varieties were chosen because their similar rate of development gives a comparable growth stage at each time of cutting. Before the initial cuts were made, the plots were reduced in length so that each sub-plot was one-twentieth acre in area. The crops were sown on fallow with normal rates of seeding and superphosphate application.

Each plot was cut with the binder at the appropriate time, weighed immediately the hay was cured and samples taken for moisture determination and other analyses after chaffing. Three representative sheaves were taken from each plot receiving the third treatment (*i.e.*, cut almost mature), weighed, threshed, in a nursery thresher, and the proportions of grain, straw and "cocky chaff" obtained. It was intended to carry out digestibility trials with sheep on the materials from each treatment, but this was found impossible owing to the demands of other work during war time. Also, unfortunately, several samples were destroyed by vermin before the required chemical analyses could be made.

The results are presented in a greatly simplified form in Table IV. Calculations of digestible nutrients were made from the chemical analyses obtained from the appropriate digestibility co-efficients of Underwood and Moir (1944) for the hay and from the "standard" digestibilities given by Morrison (1937) for the grain.

TABLE IV.
RELATIVE YIELDS OF GRAIN AND HAY CUT AT DIFFERENT STAGES.

Cut No.	Treatment.	Total Yields Dry Matter.	Total Digestible Nutrients.	Digestible Crude Protein.
		cwts. per acre.	cwts. per acre.	cwts. per acre.
A	Oats cut full bloom	34.1	...	1.4
C	Oats cut late milk to early dough stage	35.0	19.4	1.3
E	Oats cut practically mature	31.5	16.8	0.9
E (a)	Grain fraction of E	8.4	6.6	0.7
E (b)	Straw fraction of E	19.0	...	...
E (c)	"Cocky chaff" fraction of E	4.1	...	...
B	Wheat cut full bloom	36.0	19.8	1.1
D	Wheat cut late milk to early dough stage	36.9	20.6	0.9
F	Wheat cut almost mature	37.3	18.7	0.7
F (a)	Grain fraction of F	9.7	9.0	0.9
F (b)	Straw fraction of F	22.9	...	...
F (c)	"Cocky chaff" fraction of F	4.7	...	...

The total yield of grain, of dry matter of the hay, and of digestible nutrients, was slightly higher for the wheat than for the oats, at each growth stage. The grain, in each case, represented about 25 per cent. of the total yield—a ratio of straw and chaff to grain of 3 : 1. A ratio nearer 2 : 1 is more usual under Merredin conditions. The actual yields of grain were 18 bushels per acre for the oats and 21 bushels per acre for the wheat, on a 10 per cent. moisture basis.

A point of considerable importance is that the yield of total digestible nutrients from the hay underwent little change from flowering to maturity in the case of the wheat. The fall from the "optimum" hay-cutting stage to maturity in the case of the oats was due very largely to the effects of one replication. The position in regard to protein was rather different. There was a marked fall in yield of digestible protein at maturity compared with earlier growth stages. These results are essentially similar to those obtained in the earlier trials of Underwood and Moir (*loc. cit.*).

A further point which emerges from the data of Table IV. concerns the relative yields of hay and of grain. As mentioned earlier, the grain yield with both the oats and wheat in these experiments was only about 25 per cent. of the hay. This

disparity is improved appreciably when the yields of total digestible nutrients are compared, owing to the much higher digestibility of grain. In terms of digestible protein, the position was still better. With the oats the yield from the grain was nearly 80 per cent. of that of the mature hay. With the wheat there was actually more *digestible* protein obtainable from the grain than from the mature hay. That this is largely a reflection of the very high digestibility of wheat grain protein (84 per cent.) compared with mature wheaten hay protein (30 per cent.) is shown by the fact that the yields of *total* protein were as follows:—Hay, 2.3 cwt. per acre; grain, 1.1 cwt. per acre.

DISCUSSION.

It is clear that the losses of dry matter in the curing of cereal hay in the stook are negligible under typical wheat-belt climatic conditions, *i.e.*, without appreciable falls of rain during the curing period. Nor is there any measurable effect on chemical composition under these conditions. This makes it highly probable that there is no significant fall in digestibility since there is no appreciable loss of the most digestible portions of the hay. In other words, practically the whole of the nutritive value in the standing crop as cut can be conserved as hay.

It is apparent further that, under the climatic conditions described, delaying hay-cutting from the "optimum" stage until maturity results in relatively small losses of dry matter or of total digestible nutrients. Neglecting for the moment the serious losses in digestible protein there, therefore, seems to be little economic gain in earlier cutting. In the past, practically the only equipment available on wheat-belt farms for haymaking has been the binder and the cutting, stooking, and stacking of bound cereal hay has been a costly process in both time and labour. The recent development of the Pickup-baler offers new opportunities for economically conserving pastures and crops, where the amounts of fodder conserved are sufficiently large to "spread" the heavy capital costs of the machinery. In addition, some Pickup-balers are equipped with a cutter-bar which enables the standing crop to



Cutting and baling straw.

be cut. With such machines it is possible to cut and bale a *mature* cereal crop in one operation, which greatly simplifies the conservation of a good cereal roughage and greatly extends the period over which such roughages can be conserved.

It might be argued that, in spite of the very great advantages of conserving hay in this way at the mature stage, there would be a serious lowering in palatability to sheep, and hence the hay would be very wastefully used. In our experience, there is no appreciable difference, in palatability to sheep, between early cut or mature oaten or wheaten hays, when such hays are fed chaffed. On the other hand, Gross (1947) found that the more mature hay was when cut, the lower was its palatability to sheep. In these experiments it should be noted that the hay was fed as loose sheaves, giving ample opportunity for the sheep to reject straw and select "heads." When cut and pressed into bales, as with a Pickup-baler, there would be less opportunity for such selective feeding and also smaller losses of grain due to handling, in comparison with mature hay conserved and fed to sheep in the ordinary way.

THE CONSERVATION-SUPPLEMENTARY FEEDING CYCLE

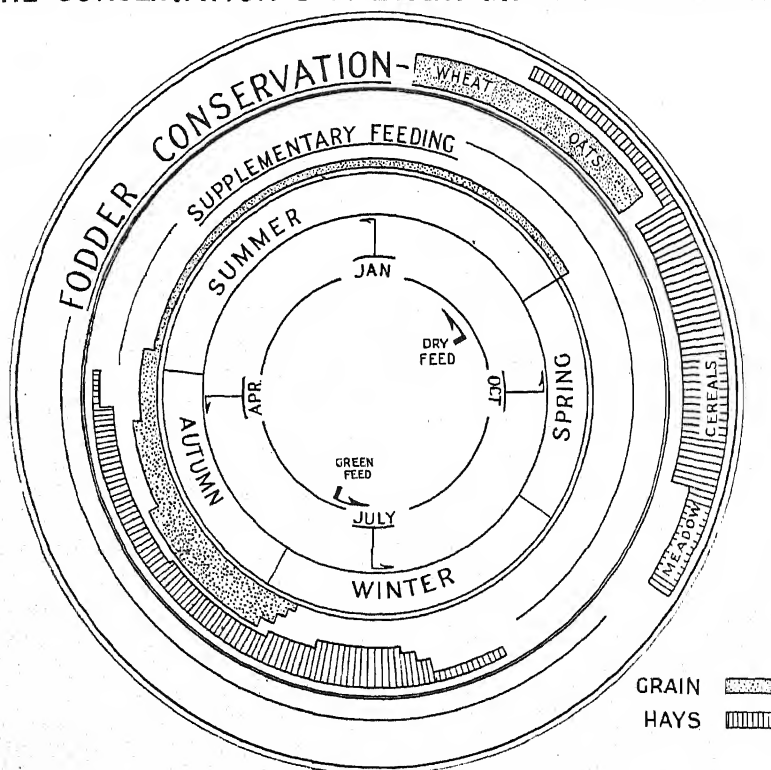


Fig. II.

Hay cut at maturity would ordinarily be much lower in carotene, or Vitamin A potency, than earlier cut hay, but it is very doubtful if this is of much practical significance. The reserves of Vitamin A in the livers of sheep at the end of the "green-feed" period of the year are apparently sufficiently high to prevent deficiency symptoms appearing during summers of normal length (Underwood & Conochie, 1941; Pierce, 1946; Underwood, 1947).

The results of the comparisons of hay and grain yields appear to provide powerful support for a programme of fodder conservation based very largely on hay. But the very much heavier yields of dry matter in the form of hay and, to a lesser extent, of total digestible nutrients, are not the only considerations. Cereal hay, cut at any reasonable growth stage, is a roughage of low digestibility and very low content of digestible protein. Grain, on the other hand, is a concentrate particularly well adapted for supplementing the poor dry grazing of the summer months. Moreover, as pointed out earlier, its digestible protein content is much higher than hay, and protein deficiency is probably the most important limiting factor in sheep husbandry at this time of the year.

With these points in mind, an attempt can be made to outline a satisfactory yearly programme of fodder conservation and supplementary feeding on a Western Australian wheat-belt farm. Such a programme is illustrated diagrammatically in Figure II.

In the late summer and autumn (March to early June) the normal rapid decline in both the quantity and quality of the available grazing necessitates hand-feeding of sheep. This should commence with a cereal grain and not a roughage such as hay, for the reasons given above. With the approach of lambing the grain supplement could well be as high as $\frac{1}{2}$ lb. to $\frac{3}{4}$ lb. per day, to reduce the chances of pregnancy toxæmia (twin lamb disease) in the ewes and losses of lambs at lambing time. At this time, cereal hay or chaff should be fed in addition to the grain. With the advent of winter rains and supplies of young green feed, the grain supplement should be reduced and soon eliminated but the hay supplement continued to enable the young herbage to be used more efficiently. Cereal hay is the logical supplement to the young green grazing available at this time of the year. With increasing bulk of pastures no further supplementary feeding will be necessary.

Conservation will commence in September with the volunteer pastures of grass and weeds as meadow hay, followed by the cereals. With the use of modern hay-making machinery, in the manner described earlier, not only can hay-making be greatly reduced in cost but the period of conservation greatly extended. The conservation programme will be completed with the cutting and baling of the mature cereal crop and finally the harvesting of grain.

So far, the discussion has been confined to wheat and oats. The development of the hooded feed barley, "Greenough," directs attention to the possibilities of this cereal and, incidentally, to a very neglected field of cereal breeding. The hooded barleys lack the barbed awns which make the common varieties of this cereal unsuitable for hay. "Greenough" withstands adverse pre-harvest weather much better than oats, and is an early-maturing variety developed primarily for the outer wheat-belt. Slightly later maturing varieties of barley would be attractive alternatives to oats for fodder in the more favoured regions.



Cutting and baling straw.

SUMMARY.

Experiments were carried out with oats and wheat at the Merredin Research Station in 1944 and 1945, to measure the losses in the curing of hay and to compare the yields of grain and of hay cut at different growth stages.

Under the curing conditions prevailing in these years, *i.e.*, in the absence of any substantial falls of rain, it was found that :—

- (i) Losses of dry matter during curing, up to four months in the stook, were negligible for both the wheat and the oats.
- (ii) No appreciable changes in chemical composition occurred during curing of the oats, from which it was concluded that there was no significant loss of digestible nutrients. (In view of this finding similar chemical analyses were not carried out with the wheat.)
- (iii) The decline in yield of total dry matter and of total digestible nutrients between wheaten and oaten hay cut at the "optimum" growth stage and at maturity was relatively small but there was a serious fall in yields of digestible protein.
- (iv) The yields of total dry matter of mature oaten and wheaten hay was nearly four times as high as the yields of grain and the yields of total digestible nutrients more than twice as high.
- (v) The yield of *digestible* protein from the oats grain was nearly 80 per cent. of that of the mature oaten hay and from the wheat grain nearly 130 per cent. of that of the mature wheaten hay. Half the *total* protein of the mature hay was found in the grain in each case.

The significance of these findings in relation to fodder conservation practice in the Western Australian wheat-belt is discussed, with particular reference to the decline in horse numbers and rise in sheep numbers and to the use of modern hay-making machinery.

A fodder conservation-supplementary feeding cycle for wheat-belt farms is presented.

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ACKNOWLEDGMENTS.

Grateful acknowledgment is made to Mr. E. Langfield for his able assistance with the field work, and to Mr. I. Thomas, Superintendent of Wheat Farming, for making the facilities of the Merredin Research Station available.

THE MANGANESE CONTENT OF WESTERN AUSTRALIAN CEREAL GRAINS AND THEIR BY-PRODUCTS AND OF OTHER POULTRY FEEDS

By

E. J. UNDERWOOD*, T. J. ROBINSON†, AND D. H. CURNOW†.

INTRODUCTION.

Manganese appears to be of little practical importance in the diet of mammals because their requirements are exceedingly small and the amounts supplied by ordinary foods are invariably greater than the animals' requirements. No naturally occurring deficiencies of this mineral have so far been recorded for grazing animals, although manganese deficiency affecting the growth, health and manganese content of a number of crops, and particularly oats, barley and wheat, has been observed in many countries including Australia. In the nutrition of poultry, on the other hand, there is ample evidence that manganese is a "trace" mineral of great practical and scientific importance.

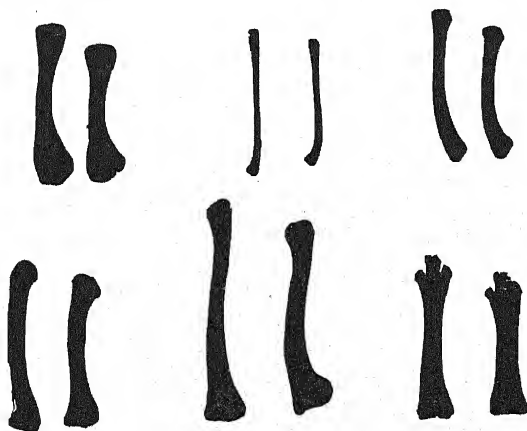


Fig. I.

Leg and wing bones of chicks four weeks old, showing the effects of manganese deficiency. (Caskey, Gallup and Norris, 1939.)

*Institute of Agriculture, University of W.A., Nedlands,

†Department of Agriculture, Perth, W.A.

The first report that poultry require manganese came from the American workers Wilgus, Norris and Heuser (1936), who demonstrated that the disease "perosis," "slipped tendon" or "hock disease" can be caused by a deficient dietary intake of manganese and can be prevented by the addition of manganese supplements. Hock disease is a leg abnormality of young growing chicks in which the bones of the legs, particularly the tibia and metatarsus, become deformed causing the tendons to slip off the "hock" joint and making it difficult or impossible for the chicken to stand. (Figure I.)

This outstanding finding has been confirmed and extended by numerous workers and it is now known that, besides causing "perosis" and inferior growth in growing chicks, manganese deficiency in laying hens results in lowered egg production, reduced hatchability and a remarkable condition in the chick embryos, known as "nutritional chondrodystrophy." In this condition the embryos are undersized and deformed with large globular heads, parrot beaks and short thick legs and wings (Lyons and Insko, 1937). (Figure II.)

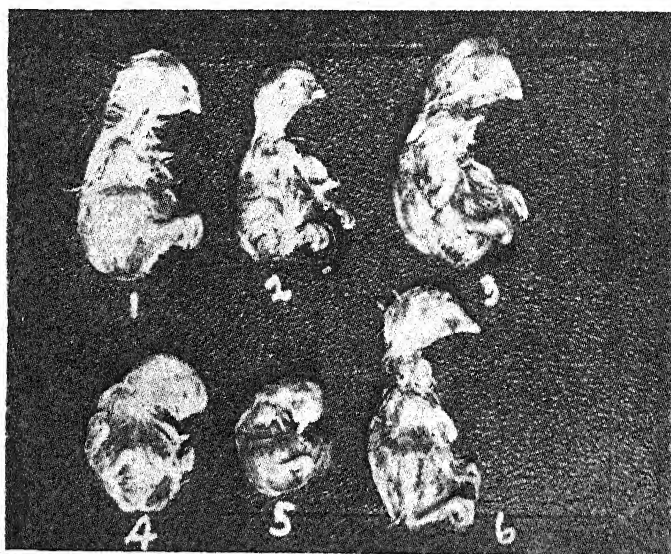


Fig. II.

Numbers 1 to 5 chick embryos (21 days) showing chondrodystrophy due to manganese deficiency in the diet of the hen. Note the very short legs, "parrot beak," globular head and protruding abdomen. Number 6, normal 21-day embryo. (Lyons and Insko, 1937.)

The minimum level of manganese in the diet of birds to prevent these disorders and to sustain optimum growth, egg production and hatchability cannot be stated exactly because it has been shown to be influenced by:—

- (a) the overall calcium, phosphorus and iron contents of the diet,
- (b) the chemical nature of the manganese supplement used (if any),
- (c) the breed or even "strain" of fowl.

Thus, abnormally high intakes of calcium and phosphorus have been shown to raise the manganese requirements appreciably. In fact, "perosis" was believed at one time to be caused by an excess of these minerals and it was by a critical study

of this hypothesis that the original discovery of a manganese deficiency was made. For all ordinary sources of manganese likely to be used as supplements, there appears to be little difference in availability, and hence of requirements in terms of total manganese, but some compounds have been shown to be poor sources (Schaible et al, 1938). The "lighter" breeds of fowl appear to have a lower manganese requirement than the heavier breeds. Thus Gallop and Norris (1937 and 1939) found that about 30 parts per million of manganese on the whole diet was sufficient to prevent perosis and for normal growth in their strain of White Leghorns, whereas about 50 parts per million was required for their New Hampshires.

Under average conditions of feeding, however, it can be stated with some confidence that the whole ration should contain not less than 40 parts per million if it is to supply adequate amounts of manganese. The figures given by most authorities range from 30 to 50 parts per million, both for growing chicks and laying and breeding hens, the lower figure approximating the requirement of the "lighter" breeds and the higher figure approximating that of the heavier breeds.

Prior to the commencement of the present work, little or no information was available on the normal manganese content of Australian cereal grains and other poultry feeds. Cases of perosis and chondrodystrophy have been reported from time to time in W.A., and low hatchability of unknown cause is a fairly common problem throughout Australia. It was therefore thought worth while to initiate a study of the manganese content of a range of W.A. poultry feeds and in particular, of the cereal grains and their by-products. In this way, it was hoped to obtain data which would enable an appraisal to be made of the manganese intakes of birds under a range of feeding practices.

Further point has been given to this study by the increasing popularity of "whole-grain feeding," following experiments at Werribee (Pederick and Clark, 1943, 1944, 1945) in which bran and pollard were eliminated from the experimental rations. Overseas workers (Schaible et al, 1938), have shown that the manganese of cereal grains is largely concentrated in the outer layers. Thus the average manganese content of wheaten grain is given by these workers as 31 parts per million, of wheaten bran, 108 parts per million, and of middlings or pollard, 101 parts per million. Titus (1941), gives 39, 119, and 119 parts per million for American wheat, bran and pollard respectively. If these figures are at all comparable with those of Australian grown grains and their by-products, it follows that any system of feeding which avoids the use of bran and pollard, will result in a reduced manganese content of the ration, possibly to the extent of affecting the growth or productivity of the birds or the hatchability of their eggs.

The possible importance of such changes in practice with respect to manganese (and riboflavin) and their relation to hatchability has recently been pointed out by McClymont and Hart (1946, 1947) in N.S.W. These workers carried out an experiment with White Leghorn pullets demonstrating improved hatchability of eggs when supplements of both manganese and riboflavin were added to a ration based on wheat but containing no bran or pollard. From the experiments actually reported it is not clear whether the improved hatchability is due to the additional manganese or the riboflavin but from the nature of the symptoms in the dead embryos produced on the low hatchability rations and from the results of further experiments (not reported in detail), these authors conclude that riboflavin deficiency and not manganese deficiency is the cause of the low hatchability and abnormalities in the chick embryos. The unsupplemented low hatchability rations in their experiments supplied 40 to 42 parts per million of manganese which, on American standards, can be regarded as adequate for a "light" breed such as the White Leghorn.

AIMS AND METHODS.

The primary object of the investigation was to find out the manganese content of a wide range of W.A. grown poultry feeds so that a fairly complete picture could be obtained of the manganese intake of poultry under the various systems of feeding practised. A further aim was to obtain similar data for a large number of samples of wheaten grain, which is the basis of poultry feeding throughout Australia, from throughout the State to gain some idea of the degree of variability in manganese content and the relation of this variability to season, district, variety, and soil type.

Accordingly, wheat samples were obtained in the 1940-41 delivery season from sidings at nearly 200 places widely spread throughout the wheat belt of W.A. (see map page 264). In most cases, the varieties were known and recorded and in a few cases, the soil type on which the wheat was grown was also known. In addition, samples of the official F.A.Q. wheat samples for the eight years 1937 to 1944, were also obtained as was a selection of wheat, barley and oats grown in different years at the Research Stations of the Department of Agriculture.

Samples of bran and pollard were obtained from six mills situated in different parts of the State. Samples of meatmeal, lucerne, elephant grass, and oyster shell, were obtained from individual poultry producers or from produce merchants in Perth.

The method of analysis for manganese used on most of these samples was essentially that given by Piper (1944). Owing to temporary shortage of potassium periodate, oxidation with ammonium persulphate had to be resorted to with some of the samples. By careful precaution, comparable results with those given by Piper's method were obtained.

RESULTS.

Wheat, Pollard, and Bran.

The results of the analyses of wheat, bran and pollard, expressed as parts per million (p.p.m.) of manganese on the dry basis, for the whole of the samples collected in the 1940-41 delivery season are given in Table I.

TABLE I.
MANGANESE CONTENT OF WHEAT, BRAN AND POLLARD (1940-41
SEASON, W.A.).

Parts per million on dry basis.

	Wheat	Pollard.	Bran.
Number of Samples	208	24	23
Mean	37	100	133
Standard Deviation	8.3	13.9	13.6
Range	19-84	62-118	114-168

It is apparent from Table I. that manganese is heavily concentrated in the outer layers of the grain and that both bran and pollard can be regarded, on the average, as rich sources of this mineral. The mean levels of manganese found in wheat, bran, and pollard are closely similar to those found by the American workers, cited earlier, for similar materials of American origin.

The range of values obtained was very large, in each case, particularly for the wheat. The distribution of the wheat samples over the range of values is shown in Table II.

TABLE II.
MANGANESE CONTENT OF WHEAT (1940-41 SEASON).

Manganese Content (ppm)...	15-19.	20-24.	25-29.	30-34.	35-39.	40-44.	45-49.	50-54.	Over 55
Number of Samples ...	2	14	24	49	43	41	20	11	4

The number of very low and of very high values is an extremely small proportion of the total number of samples analysed. Eighty-five per cent. of the samples lie within the range 25-49 ppm. and 65 per cent. within the range 30-44 ppm. It is noteworthy, however, that there is no "peak" of samples around the mean figure of 37 ppm. Actually, more samples lie within the range 30-34, and almost as many within the range 40-44, as occur in the "mean" range of 35-39 ppm.

The Influence of Variety.

Except for a few samples the actual variety of wheat was known in each case. It was therefore possible to examine the results for the different varieties separately. Different varieties of wheat, oats, and barley have been observed to vary greatly in their degree of tolerance of, or susceptibility to, manganese deficiency (Davies and Jones, 1931, and Leeper, 1934) but no data on the influence of variety on the manganese content of grain grown under comparable conditions have been presented as far as is known.

The mean manganese content, together with the standard deviation in each case is presented for the five main varieties in Table III. These together comprise three-quarters of the total samples for which the variety was known and have a wide distribution throughout the wheat-growing areas. A useful comparison can thus be made, although it must be emphasised that soil, cultural and even seasonal conditions vary widely and not necessarily in the same way within each variety.

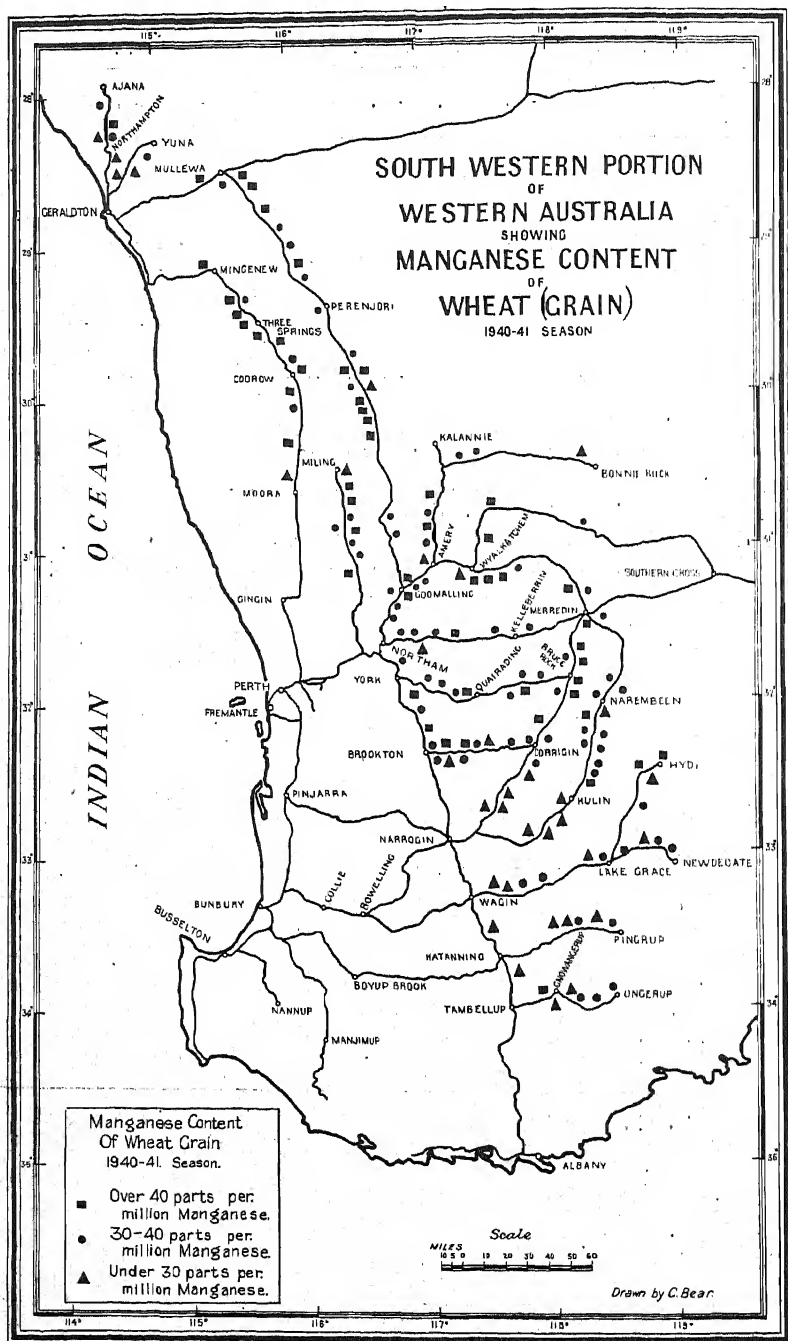
TABLE III.
MANGANESE CONTENT OF WHEAT VARIETIES.
(Ppm on dry basis.)

Variety.	Bencubbin.	Glueclub.	Dundee.	Nabawa.	Ranee.
Number of Samples ...	61	36	16	14	11
Mean	35.7	33.9	36.7	38.3	39.6
Standard Deviation ...	8.4	8.3	7.1	6.4	6.6

The small differences in the mean manganese contents of the five varieties are not significant when examined statistically. Evidently under the range of conditions represented by these samples variety is not an important factor influencing the manganese content of wheat grain.

The Influence of District.

The wheat samples were obtained from practically the whole of the wheat belt so that if there were any marked differences between districts these should be revealed. It was felt that the simplest way of doing this was to plot the results on a map. Accordingly, the results have been divided into three arbitrary groups according to their manganese content, those containing over 40 ppm. being in one group, those containing 30-40 ppm., being in another and the third group consisting of those samples containing less than 30 ppm. The distribution of the various samples comprising these groups is shown on the accompanying map.



High and low manganese samples, as well as those in the "middle" group containing 30-40 ppm., appear in practically every district. There is, however, a noticeable concentration of samples containing less than 30 ppm. in the south-eastern parts of the wheat belt, i.e., in the districts east of Great Southern at Narrogin,

Wagin and Katanning. In fact one half of the total samples in this group were obtained from these districts. It is very probable that this is a reflection of the soils of this area. Manganese deficiency in cereals and yield responses to manganese fertilisers have been reported on the ferruginous gravelly sands of these districts by Wild (1934), Stewart and Teakle (1939) and Teakle and Wild (1940). It is likely, although no evidence can be presented on this point, that a lowering of the manganese content of the grain occurs on these and similar soils even where there is no marked crop failure or obvious symptoms of deficiency. On a soil type in Victoria, which induced acute manganese deficiency symptoms in cereals, a marked lowering of the manganese content of wheat grain was demonstrated by Leeper (1934).

The Influence of Season.

Unfortunately, the 1940 growing season was exceptionally dry throughout almost the whole of the wheat belt. It was felt therefore that the results for this might be either lower or higher than those for more normal seasons. Accordingly, the "official" F.A.Q. samples obtained by the Chamber of Commerce were examined for the eight years, 1937-38 to 1944-45. The results are presented in Table IV.

TABLE IV.
MANGANESE CONTENT OF F.A.Q. WHEAT SAMPLES.
(Ppm on dry basis).

Year.	Sample.	Manganese Content.	Year.	Sample.	Manganese Content.
1937-38 ...	"Official" F.A.Q.	39	1941-42	"Official" F.A.Q.	46
1938-39 ...	do. do.	43	1942-43	do. do.	43
1939-40 ...	do. do.	47	1943-44	do. do.	44
1940-41 ...	do. do.	35	1944-45	do. do.	39
			Mean of 8 years ...	...	42

In so far as these samples are representative of the "average" wheat grown throughout W.A. in the different years it is evident that there is an appreciable effect of "season" on the manganese content of the grain. The very dry year, 1940, produced a grain significantly lower in manganese than the other years and very appreciably lower than the years immediately preceding and immediately following. In both of these years the growing season was one of above average rainfall for most of the wheat belt. The figure obtained for the 1940-41 F.A.Q. sample, namely, 35 ppm., is very close to the average of 37 ppm. obtained for the 208 samples analysed from throughout the wheat belt in this year. From the mean of the eight years, however, it would appear that 42 ppm. is nearer the "average" manganese content of W.A. wheat grown in an "average" season. This is much higher than the figure of 31 ppm. given by Schaible et al (*loc cit*) for American grown wheat, but not greatly different from the figure of 39 ppm. quoted by Titus (*loc cit*).

The Influence of Soil Type.

In most cases no information was available as to the type of soil on which the various samples were grown, although this information was asked for. In 19 cases, however, the farmer had definitely stated that his wheat came from either "heavy" forest country, "medium" timbered country or "light" treeless sand-plain. This classification of soils, based on the original vegetation carried, leaves much to be desired, although it has provided in the past a reasonably good assessment of the inherent quality of the soils from the standpoint of cereal growing. The results are therefore presented for what they are worth.

The mean manganese content of the wheats grown on the "heavy" soils was 43 ppm., that of the "medium" soil samples 48 ppm. and that of the "light" sand-plain soil samples 45 ppm. These differences are not statistically significant and in any case are too small in number to enable a satisfactory assessment to be made.

Manganese deficiency in cereals and other crops occurs particularly on some soils naturally alkaline in reaction or rendered so by very heavy liming. In this way the availability to plants of the soil manganese is lowered. Highly oxidising conditions also depress availability. Occasionally, also, manganese deficiency occurs in soils due to the extremely low absolute amounts of manganese present. Such soils have been described by Teakle, Hoare, and Thomas (1933) in the case of the lateritic "sand plain" soils of Wongan Hills. Many of the samples collected must have been grown on soils of this type, although in the case of the six samples in which this was actually known, there is no evidence of lowered manganese content of the grain as pointed out in the previous paragraph. However, a much larger number of samples would be required before any effect could definitely be established.

BARLEY, OATS, AND MAIZE.

The results of the barley, oats, and maize samples collected from different parts of the wheat belt are presented in Table V. Maize is very little grown for grain in W.A., except on one or two properties in the irrigation areas, so that only three samples were obtained, all grown in 1945. Three N.S.W. grown samples are therefore included in the table. None of the barley and oats samples were grown in the 1940 season and are therefore not directly comparable with the main wheat samples presented in Table I. Most of them were obtained during the 1943-44 and 1944-45 delivery seasons.

TABLE V.
MANGANESE CONTENT OF BARLEY, OATS, AND MAIZE.
(Ppm dry basis).

	Barley.	Oats.	Maize.
Number of Samples	15	9	6
Mean	15	43	8.6
Standard Deviation	3.9	12.5	1.9
Range	9-23	27-62	6.5-11.6

It is apparent that barley, oats, and maize grain differ widely in their average manganese contents and that wide fluctuations exist within each type of grain. Oats compares closely with wheat and exhibits a similar range of values. Barley is obviously a much poorer source of manganese and maize is strikingly low. The mean values for barley and oats, and the range of values in each case, are very similar to the figures obtained by the American workers Schaible et al in 1938 and Titus (1941), cited earlier. Their mean figures were 14 and 16 ppm. for barley and 36 and 34 ppm. for oats. The values for maize presented in Table V., although very low are, however, much higher than the mean figures of 4.9 and 5.0 ppm. given by these workers. No significant differences between the W.A. and N.S.W. maize samples included in Table V. was found. The actual values obtained were as follows:—W.A.—7.7, 8.8, and 9.8; N.S.W.—6.5, 7.3, and 11.6.

MEATMEAL.

Eight samples of meatmeal, the most important protein supplement in poultry rations, were obtained from merchants in Perth during the years 1941 to 1945. The mean manganese content of these samples was 20 ± 1.8 ppm., with a range from

11 to 25 ppm. This is extremely close to the average figure of 18 ppm. given for meatmeal and tankage by Schaible et al (*loc. cit.*). Apparently protein concentrates of animal origin are not normally particularly good sources of manganese.

GREEN FEEDS.

A considerable volume of data is available on the manganese content of pasture grasses, clovers, and cereals. The manganese content has been shown to vary widely with the species and especially with the nature of the soil on which the plants are grown. Thus Beeson (1941) in U.S.A. gives a range for 86 samples of clover of 18.5 to 875 ppm., with an average of 145 ppm. of manganese. Teakle and Turton (1943) found 93 samples of Subterranean clover leaves grown in various parts of W.A. to range in manganese content from 26 to 298 ppm. on the dry basis and 33 samples of young oats, wheat, and barley to range from 22 to 325 ppm.

Poultry normally consume much less green feed than most other classes of livestock. In W.A., however, either green chopped lucerne (*Medicago sativa*) or green chopped Elephant grass (*Pennisetum purpureum*) frequently forms a regular part of poultry rations. Accordingly, samples of these materials were collected from commercial poultry raisers in the main poultry producing areas near Perth. The results are presented in Table VI.

TABLE VI.
MANGANESE CONTENT OF LUCERNE AND ELEPHANT GRASS.
(Ppm dry basis).

	Lucerne.	Elephant Grass.
Number of Samples	9	6
Mean	26	48
Standard Deviation	8.1	35.1
Range	9-67	17-110

The tremendous range of values found for each species confirms existing evidence, including that just quoted, demonstrating the great variability which can occur in the manganese content of whole plants. Under these conditions average values are almost worthless. It is apparent, however, that even the high values of Table VI. are insufficient, at the levels at which green feed is normally fed, to raise appreciably the overall manganese content of the ration.

DISCUSSION.

Overseas workers have, as pointed out in the introduction, established conclusively that poultry require about 40 ppm. of manganese on the dry basis in their whole diet if they are to grow properly and remain healthy and for maximum production of normal eggs of good hatchability. It must be emphasised that this level of 40 ppm. is only an average figure. There is evidence that a slightly lower level of manganese is sufficient for the "lighter" breeds, such as the White Leghorn, and also evidence that a considerably higher level is necessary where the rations contain large amounts of bonemeal or other calcium and phosphorous supplements. However, 40 ppm. can conveniently be taken as a basis for calculation of the adequacy or otherwise of diets made up from W.A. grown poultry feeds, the manganese contents of which have been presented above.

A serious difficulty in any such calculations is the great variability in manganese content which has been shown to exist within each class of foodstuff. This is particularly striking with the large series of wheat samples analysed which ranged in manganese content from 19-84 ppm. Variation of this order was also found, as would be expected, among the bran and pollard samples. Very great variation also occurred among the other cereal grains and also in the comparatively small number of "green feed" samples analysed. The results for the "green feed" samples are not surprising since many other workers, including Teakle and Turton (1943), quoted earlier, working in W.A. on Subterranean clover and wheat, oats, and barley, have similarly found very large variations in the manganese content of whole plants. Such a large variation in the manganese content of grain is, however, surprising and remarkable in comparison with the variation commonly found with such "major" minerals as calcium, phosphorus, chlorine, etc. Further studies designed to elucidate the factors determining the manganese content of grains, as well as of whole plants, are badly needed.

Under these conditions it is obvious that the use of "averages" in calculating the manganese content of rations is rather a hazardous procedure. Nevertheless, certain facts seem fairly clear from the foregoing data. It is clear, for instance, that maize is invariably an extremely poor source of manganese for poultry and that barley, although not quite so bad, is also a very poor source. Where these grains comprise a high proportion of the ration, therefore, a manganese supplement is essential. This merely confirms for W.A. conditions previous American findings. It is apparent also that bran and pollard are invariably rich sources of manganese. Rations composed of appreciable proportions of these materials are unlikely to need additional manganese.

Calculations to support these statements seem hardly necessary but one example can be given. A "standard" ration, such as is fed to birds participating in the Muresk Agricultural College Egg-Laying Trials, composed of a "morning mash" of wheatmeal, bran, pollard, meatmeal, and bonemeal, plus chopped greenstuff in equal parts by volume of the mash (approximately 8 per cent. in terms of dry matter), together with whole wheat in the evening, contains an overall manganese content of about 65 ppm. on the dry basis. This figure was obtained by using the average manganese figures submitted above for W.A. grown feeds and an average overseas (U.S.A.) figure of 13 ppm. for bonemeal. This overall level is sufficiently high to allow for the considerable variations possible in the manganese content of the constituent feeds and renders the chance of deficiency very remote indeed.

Under conditions of whole grain feeding, on the other hand, and particularly where mixed grains including equal parts of wheat, oats, barley, and maize are fed, the position is very different. Thus substitution of average W.A. manganese figures in the rations consumed in the Werribee experiments reveals a manganese content of the whole rations of approximately 32 ppm. on the dry basis. This allows 40 ppm. for the green feed with a consumption at the rate of 5 per cent. on the dry basis of the grains consumed, but makes no allowance for the oyster shell. The American workers obtained some very high figures for the manganese content of some samples of oyster shell, but in W.A. no figure higher than 20 ppm. has yet been found for the few samples analysed. 32 ppm. of manganese on the whole ration is appreciably below the "safe" level of 40 ppm. quoted earlier, and in view of the great variability in the manganese content of the constituent feeds and the chances of many samples being much lower than the average figures used in arriving at this level, it is considered advisable to provide a manganese supplement wherever such rations are used. A convenient means of doing this is to incorporate $\frac{1}{2}$ per cent., of finely ground manganese sulphate in the salt made available to the birds or mixed into the ground grains.

Where wheat only or wheat and oats is fed as the grain portion of the ration that is without barley or maize, the manganese position is more satisfactory owing to the higher average manganese content of wheat and oats compared with barley and maize. With such rations no manganese supplement would normally be necessary. This conclusion is supported by the hatchability experiments of McClymont and Hart (1946, 1947) reported earlier.

SUMMARY AND CONCLUSIONS.

The manganese content of a large number of Western Australian grown samples of wheat and its by-products bran and pollard, of oats, barley and maize, and of other poultry feeds is presented.

It was found that :—

- (i) The mean manganese content of the "official" F.A.Q. samples of wheat for the eight years 1937-38 to 1944-45 was 42 parts per million (p.p.m.) on the dry basis. The figures ranged from 35 p.p.m. in the 1940-41 season, following an exceptionally dry year, to 47 p.p.m. in 1939-40 following an unusually wet year.
- (ii) The mean manganese content of over 200 samples of wheat taken from centres throughout the wheat belt in the 1940-41 season was 37 p.p.m. The range of values was very large (19-84 p.p.m.) but 65 per cent. of these samples fell within the range 30-44 p.p.m.
- (iii) There were no significant differences in the mean manganese content of the five main varieties of wheat, which together made up more than two thirds of the total samples.
- (iv) High, medium and low manganese content samples of wheat occurred in practically every district in the wheat belt from which samples were obtained. A noticeable concentration of samples containing less than 30 p.p.m. occurred, however, in the districts east of the Great Southern railway at Narrogin, Wagin and Katanning, where manganese deficiency in cereals and yield responses to manganese fertilisers have been reported (see text) on ferruginous gravelly sands.
- (v) Manganese is heavily concentrated in the outer layers of the wheat grain. The mean manganese content of 24 samples of pollard and of 23 samples of bran, obtained in 1941, was 100 p.p.m. and 133 p.p.m. respectively. The range of values in each case was large.
- (vi) Oats, barley and maize grains differed markedly, on the average, in their manganese content. Oats contained a mean of 43 p.p.m., barley 15 p.p.m., and maize only 8.6 p.p.m.
- (vii) Meatmeal was not a good source of manganese—eight samples averaged 20 p.p.m. and all fell within the range 11-25 p.p.m.
- (viii) The manganese content of whole green plants of lucerne (*Medicago sativa*) and Elephant grass (*Pennisetum purpureum*) was extremely variable. Nine samples of the former ranged from 9-67 p.p.m. and six samples of the latter from 17-110 p.p.m. on the dry basis.

These results are compared with overseas data and their significance discussed in the light of present knowledge of the manganese requirements of poultry.

It is concluded that :—

- (i) Where bran or pollard comprises a proportion of the daily "mash," rations composed of Western Australian grown feeding-stuffs will normally provide ample manganese to meet all the requirements of growing or laying birds.

- (ii) Where a system of "whole-grain" feeding is practised, the manganese intake will probably be adequate in most cases when wheat or oats or both constitute the bulk of the grain fed.
- (iii) Where barley or maize or both constitute 50 per cent. or more of the ration, under a "whole-grain" system, it is considered advisable to provide a manganese supplement to avoid the possibility of manganese deficiency. A cheap and convenient means of doing this is to incorporate half per cent. finely ground manganese sulphate into the salt made available to the birds.

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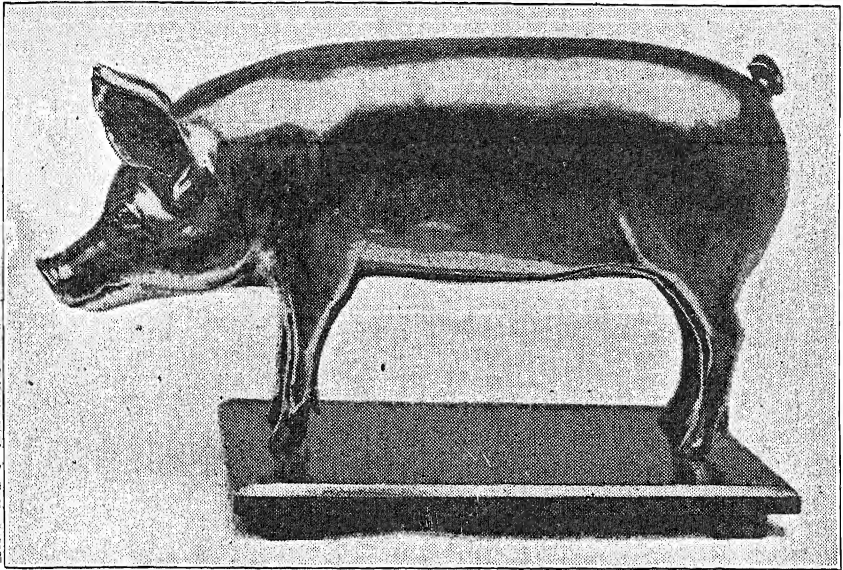
Grateful acknowledgment is made to Mr. A. J. Hoare, A.A.C.I., and others of the W.A. Government Chemical Laboratory for assistance with the analyses of the samples of meatmeal, lucerne and elephant grass, and to Co-operative Bulk Handling, Ltd., for their assistance in providing the large number of wheat samples in the 1940-41 season.

POINTS ON PROFITABLE PIG-RAISING.

V. B. MONTI, DAIRY SUPERVISOR.

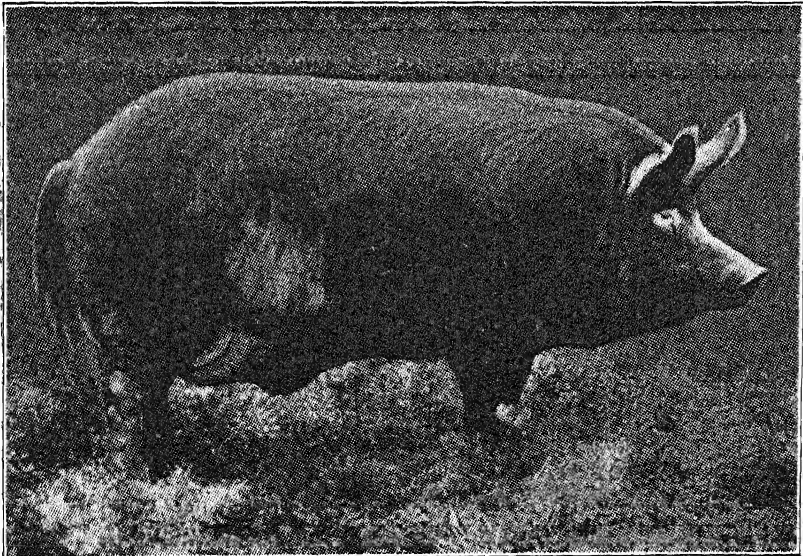
Today, with the high prices being obtained for pigs, it would appear that pig-raising is a lucrative side-line to any dairy farm, but the increased price on analysis is not so real, as is at first apparent, being offset by the high cost of wheat, protein supplements, construction materials and labour, so if a real profit is to be obtained, pig-raising must be treated as a science, and a careful analysis of management made. It is hoped the following notes may prove a useful guide in economical pig-raising.

The aim is to produce the right type of baconer, weighing 160-170 lbs. in six months. With present prices averaging over a shilling a pound, this pig is definitely profitable.



Model of Standard Type of Bacon Pig, in chrome-nickel, prepared by Western Australian Branch of Australian Pig Breeders' Association, as a guide to breeders and farmers in the selection of breeding stock for bacon production.

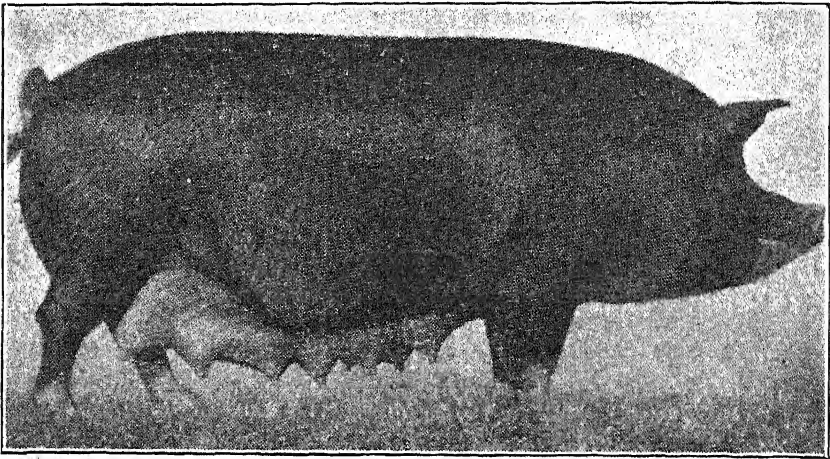
How is it to be obtained ? Firstly by breeding from the right type of pigs which have a family history of being economical converters of food to flesh. The pig is the most economical of all farm live-stock in the utilisation of food, requiring only 400-450 lb. of air dried food per 100 lbs. of live weight gain, compared with twice



Tamworth Boar. Improved type; note hams, capacious body, small head.

that figure in lambs and calves. It is reasonable, under proper conditions of selection and management to expect a live weight average gain of 1 lb. per day from birth to marketable age. So select from a line of proven "good doers."

As the boar is likely to leave upwards of 1,000 piglets during his useful life, too much emphasis cannot be placed on the acquisition of the right type of sire. Do not begrudge the 20 guineas that may have to be paid for a pure bred animal of that type. Points to be considered are light lean head, light jowl, light shoulder, well sprung ribs—avoid the animal pinched in behind the shoulder—long level back or slight arch permissible, large good quality hams, the rear appearance giving a decided "U" as against "V." The legs well placed and the pig standing upright, the bone of light, good quality and the hair relatively sparse and soft. Twelve good well spaced teats are always to be looked for.



A typical brood sow of the Improved Type Berkshire.

The points in selecting a sow are very similar to the above, but if possible always select sows from large litters of proven good mothers. It is useless a sow having a prolific capacity for the production of young unless she has the added attributes of motherhood in being able to successfully rear a large brood. Docility is always a good point in the breeding sow, as then assistance can always be rendered without upsetting the animal, with consequent risk of damage to the litter. Select sows from a good source in your own district if possible, as the animals are acclimatised and used to the feeding conditions prevailing in the area. This is a point well worthy of consideration in the dairying districts as sows imported from the wheat belt and used to heavy grain feeding take some time to accustom themselves to a main diet of skim milk.

Having selected your breeding animals, the next point is mating. Your boar is a valuable animal, so do not waste him, by allowing him to run with the sows, one service at the beginning of the heat period and one near the end is ample. Record the date of service so that the sow may be moved to suitable quarters for farrowing and the necessary supervision given during confinement.

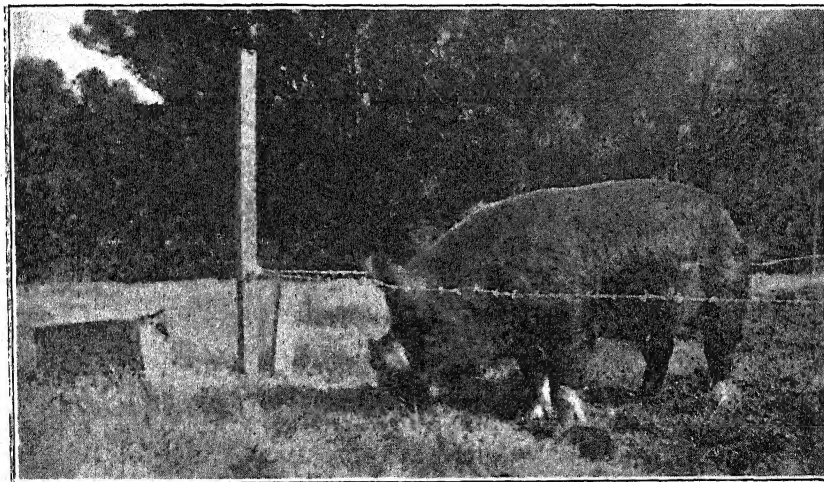
The boar should have a well grassed run (Kikuyu and clover is excellent), a weather-proof shed and access at all times to fresh pure water as well as his usual ration of grain, milk, mineral supplement and, if required for heavy service, the protein supplement should be increased.



Sows grazing on good mixed pasture need little other feeding until near farrowing time.

Brood sows should have the same conditions as above. Large areas of run will prevent undue rooting on behalf of the animals. A lick, composed of 112 lbs. of sterilised bonemeal, 20 lbs. slaked lime, 10 lbs. of coarse salt, 5 lbs. of powdered copper sulphate and $\frac{1}{4}$ of an ounce of cobalt chloride, made into a solution and well mixed through the other ingredients, is a good general lick fed at about an ounce per head per day.

An electric fence is a handy aid in pig grazing, as "once bitten" pigs respect the wire forever after.



The sow should be removed from the paddock to her farrowing pen at least a week before farrowing, to enable her to familiarise herself and settle down to her new surrounding. She should now receive an allowance of cut greenstuff each day and bran can be added to the concentrate diet as its laxative properties are particularly helpful at this time. Do not feed for at least 24 hours after farrowing

and then only a light feed is necessary, but gradually increase succeeding feeds until the sow is receiving as much as she will consume. The reason for not feeding until some time has elapsed after parturition is because, being fatigued after the meal, she will naturally lie down to the neglect of her litter and possibly lie on a number of the new born. A farrowing rail is a device well proven in its worth, and a new idea stated to further reduce loss of young piglets is to give the floor of the farrowing pen a fall of an inch and a half to the foot, the theory being the farrowing sow likes to have her back up hill and the piglets, being likewise weak on their feet, tend to wobble down hill out of the way. The sow should be provided with plenty of warm litter to make a bed for herself and family. Creep feeding of piglets from three weeks onwards is essential if the pigs are to avoid a setback at weaning time. If skim milk is short, see that the first pigs to receive an adequate ration are your young growing pigs, as they need the extra protein for skeletal development.

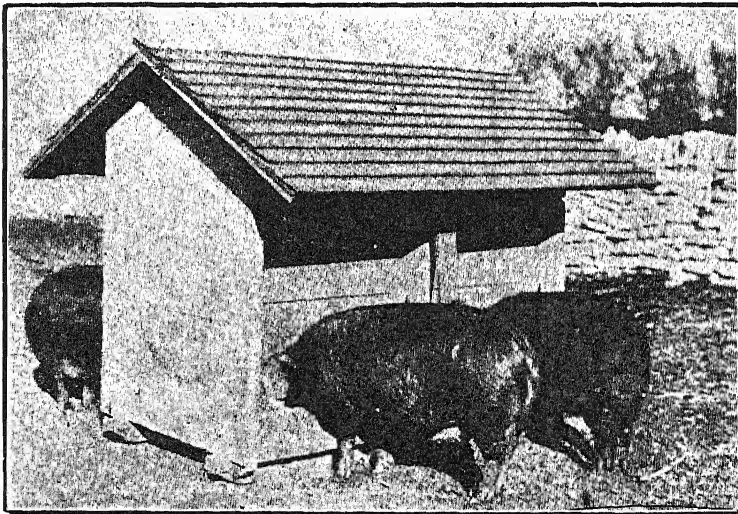
Weed out the runts. Why spend time and money in feeding an animal that is probably not going to clear expenses? Let the little extra feed go to the profit makers.

Pigs at all stages should be kept in sanitary surroundings if loss by disease is to be prevented. Good drainage is essential.

Castrate at two weeks old to give the piglet plenty of time to get over the operation while still being suckled. Pigs should be marked at this time also so that their later progress can be traced.

Wean the piglets at eight weeks by moving the sow from the yard for preference and remate three to four days later.

The young pigs should have, at all times, an adequate ration of greenstuff and protein rich supplement. *Keep them growing.* Once a pig receives a check to growth, it ceases to be a profitable proposition.



The Self-Feeder working.

At 11 to 12 weeks the young pigs can be given an open run with plenty of greenstuff and self-feeders. Here a note of warning must be sounded, as self-feeders can prove very wasteful. Two devices to prevent waste are self-closing lids which

the pigs soon learn to open. This prevents loss from wind, poultry and other animals and prevents souring with attendant digestive troubles. Pigs tend to waste food by a sideways swing of the head so the placing of traverse bars six to eight inches apart for weaners and young pigs and 10 to 12 inches for baconers usually pays good dividends. Having the self-feeder mounted on a concrete platform with a gutter to collect spilt grain is also an advantage. Always crush grain, as this prevents the pigs from eating their own droppings, which unsanitary habit greatly increases the liability to worm infestation with its consequent drastic loss to the pig farmer. Digestibility is also increased. Excessive feeding can be wasteful. Pigs are sometimes carried overweight with an obvious increase in the cost of production without realising any more in the saleyard.

The necessity of breeding from a line of "good doers" has been emphasised before, but it is just as well to reiterate at this stage, as various families vary widely in their ability to convert foodstuffs to pork.

Feeding undamped grain from open windblown troughs is also a wasteful practice.

As labour is an expensive item in pig production, all water and skim milk should be piped to the yards, the water supply float controlled and the milk supply manually controlled.

Heavy losses may occur if incorrect feeding methods are adopted during the breeding period. Exercise and ample green feed should be coupled with a mineral supplement and a good diet. Over-fatness is the one point to be guarded against at this period.

At four to five months the pigs should be again yarded and fed greenstuff twice a week. Overfeeding of greenstuff at this stage is liable to discolour the fat. The protein portion of the ration can also be decreased with a corresponding increase in the carbohydrates. At five to six months the pig should be ready for the market and little more remains to be said except that pigs free from vermin and filth present a better appearance in the saleyard and consequently realise a few shillings higher price. Never over-heat the pig on sale day, nor in loading or handling use methods that are liable to bruise the carcass or otherwise deteriorate its appearance. If the day is hot, cut some boughs to shade the waggon or truck used to cart the pigs to sale. Allow access to water but do not feed.

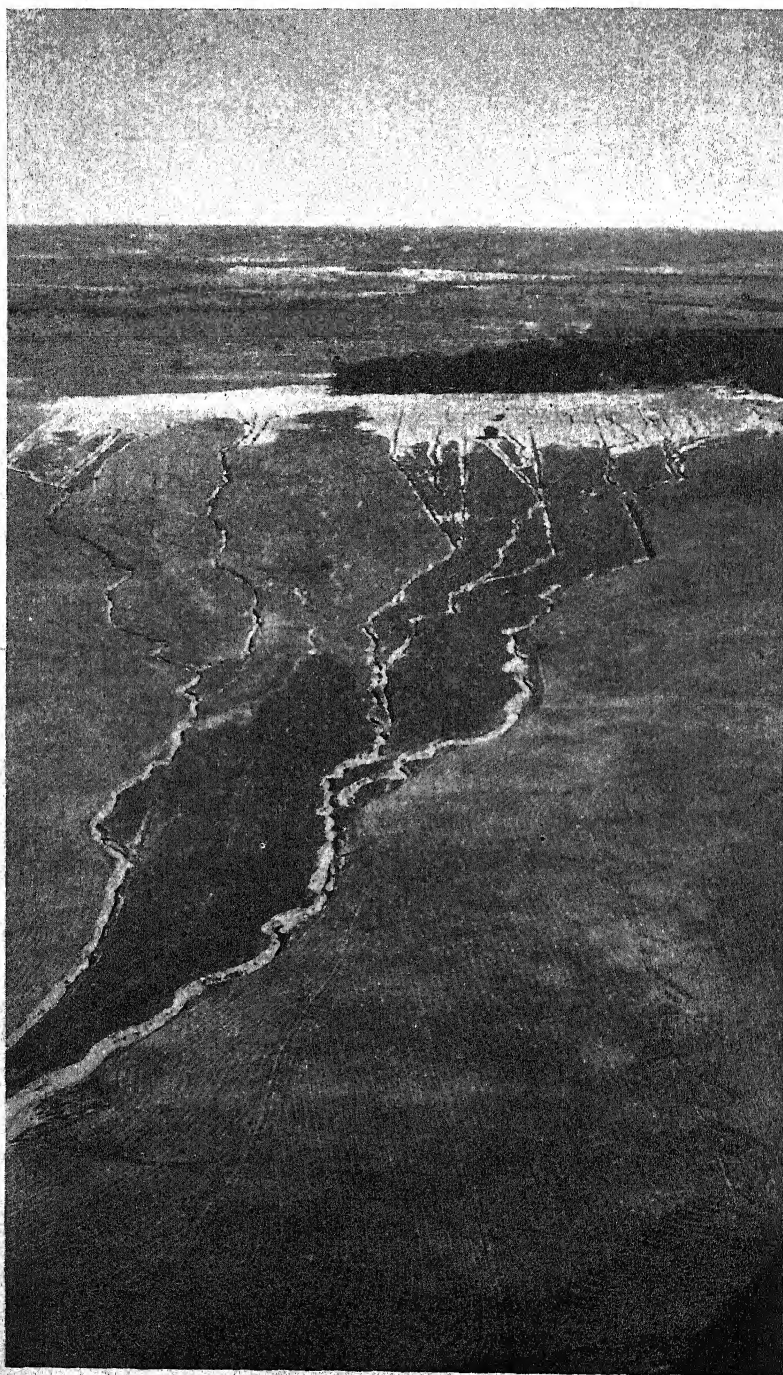
SOIL CONSERVATION AND FARMING PRACTICE.

By G. H. BURVILL, Commissioner of Soil Conservation.

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At the present time millions of the world's peoples are short of food, clothing and shelter, even in some countries where prior to 1939 supplies were more or less adequate. The war caused big changes in production and distribution which will take time to rectify, and Australians are fortunate to live in a country which produces food in excess of its people's needs.

But even though Australians have adequate food and clothing, and can produce a surplus to export, it is an opportune time to remind ourselves of the important, in fact, indispensable, part played by the soil in the production of our food, our



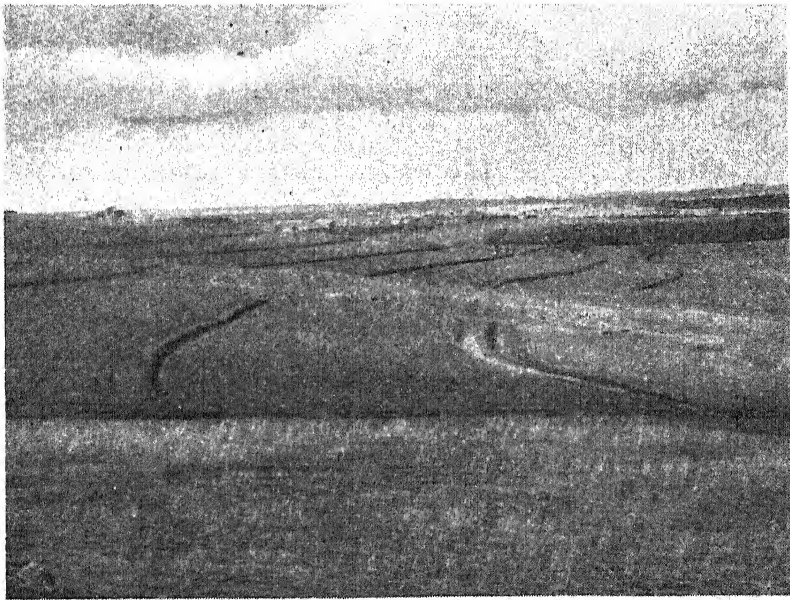
Water erosion in the wheat belt. Erosion by gullying is the most obvious, though perhaps not the most destructive form of water erosion. Uncontrolled gullies make paddocks awkward to work.

Air Photo: by Kingsley Watson.

clothing, our warmth and our shelter. It requires only a few moments of thought to appreciate how much of our daily living and comfort has been derived from plants grown on the soil, or from animals which have depended on plants, and hence the soil, for food.

The soil is, therefore, a basic factor in mankind's existence on the earth, and soil conservation is vital to everyone, be he farmer or city dweller. To the farmer it has most direct concern, for the soil is the basic asset of his farm and his livelihood. If he can preserve and improve his soils then the national aspect is secure.

What should a farmer do to conserve and improve his soils, and especially to prevent their erosion and removal by water and wind ?



Graded banks and working on the contour help control water erosion. Filled in gully (centre) can now be worked across.

Photo: Government Printer.

Firstly, he should try to understand as much as possible of the soil make up, and the way it functions in supplying essentials for plant growth. Secondly, he should strive to adapt his farming practices so as to assist and improve the soil to carry out those functions. In other words "use every acre according to its capabilities ; treat every acre according to its needs."

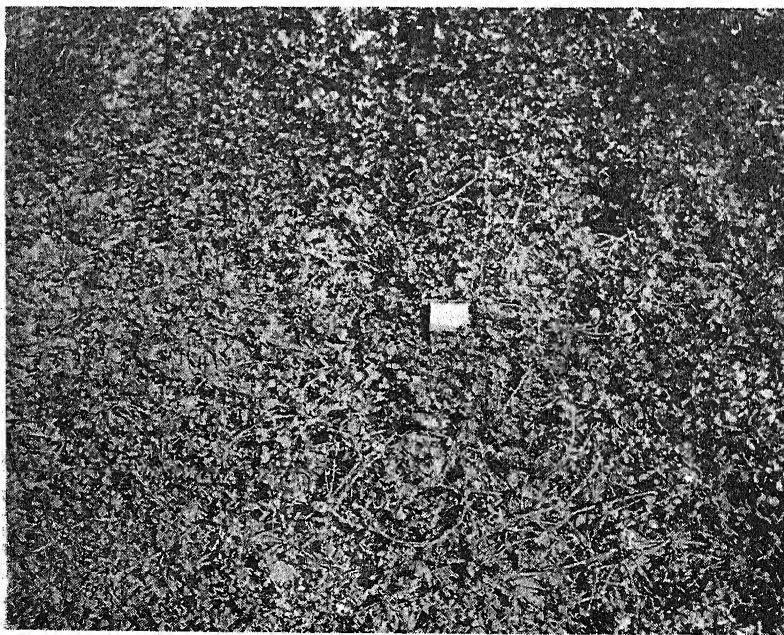
Soil is the natural medium from which plants get mechanical support and from which, through their roots, they absorb water and many essential elements for successful growth. The soil is the thin outer layer of the earth's crust, and is usually only a few feet thick. It is produced in nature by the action of the weather, and of plants and animals, on the rocks of the earth's crust. The rocks and rock minerals are broken up and decomposed, and some new minerals with sticky clay properties formed. The dead remains of plants and animals which have lived on and in the soil partly decompose and provide humus. This humus darkens the surface layers and has important functions in supplying nitrogen, and holding moisture and plant nutrients such as phosphate and potash. Teeming millions of bacteria, fungi, and other

microscopic living organisms work ceaselessly in the upper layers of the soil, making over dead plant and animal remains into simpler products. These can be taken up again by plants or help to keep the soil in good condition for water absorption and aeration—the condition the farmer calls “good tilth”. The soil is not just a mass of broken-up rock but a dynamic, ever changing, complex of mineral matter, organic matter—both dead and living—moisture and air.

By processes of natural erosion soil is transferred from place to place by running water and wind. Nature’s protective mantle of vegetation generally allows this to occur no faster than new soil can be produced. But to meet man’s need, it has been necessary to remove the natural vegetation to grow crops or pastures and farming practices must be adapted to fit in with nature, and so prevent accelerated removal of the very valuable topsoil. When topsoil is shifted away by water and wind faster than under natural conditions, then soil erosion—*man made* soil erosion—is in progress.

Where soil erosion has already occurred or is actively in progress, special control measures, as well as altered farming practices are frequently necessary. Where no erosion, or only slight erosion is apparent, farmers still have an obligation to themselves and to the nation to make conservation farming their deliberate goal.

The natural contribution which living and dead plants make to the protection and fertility of the surface soil is a basic principle in conservation farming. This means that, if possible, the soil should not be left bare, and that crop remains should be left for surface protection and ultimate breakdown to humus, unless there is some special reason for their destruction.



Subterranean clover—a valuable ally in soil conservation and soil improvement on lighter soils in areas with over 14 inches annual rainfall.

Photo: Government Printer.

Under Western Australian conditions there are few farms, except those devoted to special crops such as fruit, vegetables and tobacco, which do not carry stock. Therefore, the establishment and improvement of pastures can have direct benefit as well as contributing to soil conservation. On all soils, and in all types of mixed farming, periods of pasture are desirable. This is especially true where slopes are steep or where the soils are sandy and liable to wind erosion. Plants of the legume family such as clovers and trefoils are of special value for grazing and soil improvement purposes. As a specific example, subterranean clover seems destined to be a great ally in soil conservation efforts. It is best adapted to sandy and gravelly and other light soils, and these are the very soils most subject to water and wind erosion. Enterprising farmers are extending subterranean clover into lower rainfall areas on suitable soils, and where the annual rainfall is over fourteen inches there is ample evidence of success. The management of pastures is important. Overgrazing and lack of superphosphate topdressing may greatly offset their value in soil conservation.

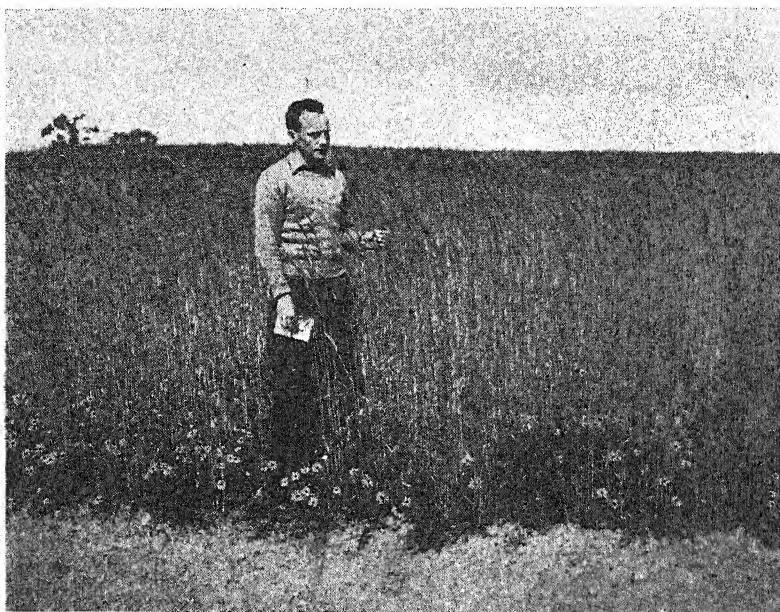
The advice that soils should not, if possible be left bare, immediately brings to mind the practice of fallowing. Fallowing involves leaving the soil more or less bare for several months prior to the planting of a crop, and in most cases has resulted in better crops. Many soils of medium and heavy texture on flat or gently sloping areas can be safely fallowed without fear of serious erosion. But even in such



Wind erosion, Newdegate district. Exposed stumps and roots indicate amount of wind erosion.

Photo: G. H. Burvill.

cases, excessive working of the soil, especially when dry, should be avoided. A rough surface, with some grass or straw trash, reduces wind velocity at ground level, and so too, the likelihood of wind erosion. Excessive working with implements can also reduce the capacity of the soil to absorb water rapidly, and it is quite obvious that ability to absorb water is a first line of defence against water erosion. Fallowing of sandy soils should aim to leave them rough and ridged, and in some cases grazing crops of oats or rye may be grown, and the fallowing done later in the season after partial grazing. Where the rainfall is sufficient to grow subterranean clover the soils on which it grows will, in most cases, later produce cereal crops without the use of a fallow period.



Cereal rye is a valuable crop for stabilising drifting sands. In the seedling stage it is not cut off by sand blast.

Photo: Government Printer.

Sloping lands in the fifteen to twenty-five inch rainfall areas of Western Australia probably have the most urgent need for conservation farming practices. Besides the help from pastures and reduction in fallowing they need contour farming, and in some cases contour or grade banks, to assist. But it should be specially noted that contour and grade banks, sometimes thought to be the first essential in erosion control, will not be effective unless coupled with other sound farming practices.

GRADE HERD RECORDING.

R. A. PAUL (Acting Superintendent of Dairying)
and
G. W. R. SCOTT (Dairy Instructor).

This is the first annual report of Grade Herd Recording since the season 1941-42, when operations were suspended for the duration of the war.

Negotiations to commence again started early in 1946, with the result that 21 units were formed and the first test carried out in May of that year.

Seasonal conditions were not very favourable during the year under review, as after a good opening in April and May, very heavy rains were recorded in June and again in August resulting in slow pasture growth. September proved favourable but once again a dry October was experienced, with the result that the growing period for pasture was shortened and hay crops were lighter than expected. No useful rain then fell until towards the end of the testing season in March.

TABLE 1.
AVERAGE PRODUCTION PER COW, 1934-47.

Year.	No. of Cows.	Milk.	Test.	Butterfat.
		gals.	%	lbs.
1933-34	4,308	415	4.35	180.60
1937-38	10,033	486	4.59	223.10
1938-39	12,368	487	4.48	218.70
1939-40	11,479	462	4.51	208.30
1940-41	9,609	447	4.45	199.00
1941-42	{ 7,081	496	4.52	224.02
	{ *5,695	502	4.61	231.78
1946-47	11,944	420	4.36	181.00

* Excludes four units tested for from six to seven months only.

Table I shows the average production per cow for the initial year of testing 1933-34 and each year from 1937-38.

It is interesting to note that in the initial year that 4,038 cows gave an average production of 415 gallons of milk and 180.6 lbs. butterfat, almost identical figures as the year under review when 11,944 cows gave 420 gallons of milk and 181 lbs. of butterfat.

Various reasons may be advanced for the decline in the average production per cow, not least of which would be the rationing of superphosphate during the war years, the lower quality of that fertiliser and shortages of labour, materials and foodstuffs. However it is as well to bear in mind that farmers did not have the advantage of having their cows tested so that any culling, or replacement was not done with the sure knowledge that the best results would be obtained. Obviously considerable ground remains to be recovered due to lack of testing facilities for five years.

TABLE 2.
PRODUCTION PER COW IN EACH UNIT.
(Units listed in order of merit.)

Unit.	No. of Herds.	No. of Cows.	Percent- age of Heifers. †	Milk. Av.	Test.	Butterfat Av.
				lbs.	%	lbs.
1. G. Cowaramup, North ...	21	548	38	4,930	4.58	228.00
2. F. Metrioup	23	541	39	4,784	4.53	216.70
3. J. Rosa Brook	22	606	30	4,375	4.57	201.90
4. E. Ruabon	19	669	33	4,834	4.17	201.60
5. B. Waroona	16	566	33	4,516	4.40	198.00
6. H. Cowaramup, South ...	17	481	30	4,792	4.06	194.90
7. L. Donnybrook	22	558	36	4,045	4.34	193.00
8. C. Harvey	15	538	15	4,446	4.32	192.00
9. W. Denmark	20	421	33	4,224	4.53	191.67
10. I. Margaret River	23	549	37	4,214	4.44	187.40
11. A. Pinjarra	18	596	20	4,338	4.20	184.00
12. M. Balingup	23	742	23	4,233	4.29	181.53
13. D. Brunswick	14	461	*	4,025	4.50	181.00
14. U. Nannup	23	675	20	3,978	4.28	170.00
15. O. Manjimup	22	603	22	3,965	4.23	167.80
16. N. Bridgetown	21	670	26	3,897	4.29	167.50
17. T. Albany	22	505	33	3,831	4.33	166.00
18. K. Forest Grove	25	741	15	3,544	4.61	163.30
19. R. Wilga	21	454	35	3,560	4.60	162.00
20. S. Mt. Barker	23	613	36	3,725	4.25	158.53
21. P. Pemberton	22	407	13	3,777	3.99	148.37

* No. of Heifers not available. † Including two and three year olds.

Table II gives the average production per cow in each unit in order of merit. An analysis of the Table shows that the production in 8 of the 21 units is below the average for the State. Little further comment is called for in regard to this Table, but from the records of previous years it is shown that those units that test year after year usually show the best productions within a comparatively short time. This of course would only apply to those units where there are no frequent changes in the herds under test. It is only from continuous testing that farmers can expect to get the maximum benefit. In this connection the performance of the herd of Mr. O. Foan, Donnybrook is an outstanding example. In the year 1933-34, this herd of 14 cows was 12th in the unit, the following year 9th, and the next year 3rd. The next year, 1936-37, it topped the unit with a production of 319 lbs. butterfat from 21 cows. Each year since then this herd has topped the averages in the Donnybrook unit, the highest average production being 359 lbs. fat in 1937-38. Entering test again during the year under review, Mr. Foan once again topped the averages not only in the Donnybrook unit, but in the State. During the year, his herd of 24 cows averaged 344 lbs. fat.

This is a fine performance and reflects great credit on the owner.

Table 3 sets out the herds grouped according to production. In the comparison with other years, it is clearly shown that improvement is called for. For the year 1946-47, 65.7% of the herds produced less than 200 lbs. per cow, compared with only 43.7% in 1939-40; 52.9% in 1940-41 and 26.2% in 1941-42.

TABLE 3.

HERDS GROUPED ACCORDING TO PRODUCTION.

Butterfat per head (lbs.).

Year.	350-400.	300-350.	250-300.	200-250.	150-200.	100-150.	Under 100.
	%	%	%	%	%	%	%
1933-34 ... ..	...	1.3	3.9	20.3	53.6	18.3	2.6
1939-40 ... ..	...	3.2	18.5	34.6	32.9	9.7	1.1
1940-41 ... ..	...	1.5	13.9	31.8	39.4	12.7	.8
1941-42	1.6	8.2	21.9	42.1	21.5	4.7	...
1946-47 ... ..	...	1.2	7.9	25.2	39.9	22.4	3.4

Table 4 gives the production of all cows grouped according to production of butterfat, and whether they are mature or heifer class.

Here again is shown the fall in the higher range productions as compared to 1942.

TABLE 4.

COWS GROUPED ACCORDING TO AGE AND PRODUCTION.

(Cows tested less than 90 days excluded.)

Groups according to Butterfat Production (lbs.).

Age.	Over 600.	500-600.	400-500.	300-400.	200-300.	150-200.	100-150.	Under 100.	Total Cows.	Year.
	%	%	%	%	%	%	%	%		
Mature...	0.02	0.3	2.4	21.8	46.4	17.4	8.7	3.0	4,287	1942
Do. ...	...	0.07	0.68	7.97	35.16	26.37	20.13	9.62	8,711	1947
Heifers...	...	0.05	0.2	5.8	36.9	27.5	20.2	9.4	1,978	1942
Do. ...	...	...	0.1	3.2	25.5	29.4	25.8	16.0	3,232	1947



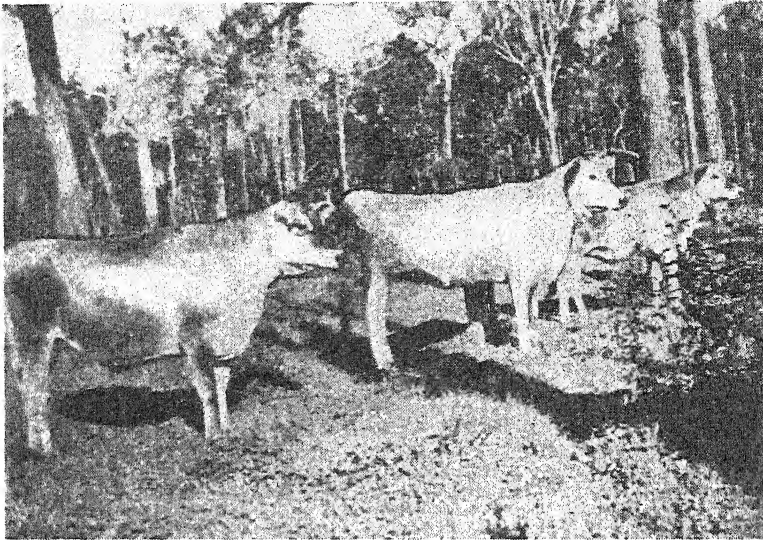
Portion of Mr. O. Foan's high producing herd. Showing the foundation cow in the foreground.



Grade cow showing type and quality, an acquisition to any herd. Produced 148 lbs. fat in first two testing periods. Owned by O. Foan, Donnybrook.

In Table 5 is given the production of cows according to the month of calving. Data published in past reports from 1936 onwards, showed that there was an optimum period for cows to calve. This is once again borne out for the year 1946-47, and

in Table 5 the results for 1946-47 are given, as well as all the figures for the seven years for which statistics have been taken out. The figures show that cows calving in the months March to July can reasonably be expected to show higher production than if calving in any of the other months.



High class Jersey grade heifers.

TABLE 5.
PRODUCTION OF COWS ACCORDING TO MONTH OF CALVING.

Month.								Average Butterfat. 1946-47.	Average Butterfat. 7 years 1936-42 and 1946-47.
								lbs.	lbs.
January	...	...	...	...	...	...	...	170.3	187
February	...	...	...	...	...	...	...	181.4	201
March	...	...	...	...	...	...	...	217.1	222
April	...	...	...	...	...	...	...	217.6	236
May	...	...	...	...	...	...	...	206.5	236
June	...	...	...	...	...	...	...	195.8	233
July	...	...	...	...	...	...	...	184.0	226
August	...	...	...	...	...	...	...	153.0	199
September	...	...	...	...	...	...	...	130.3	177
October	...	...	...	...	...	...	...	114.4	176
November	...	...	...	...	...	...	...	125.4	184
December	...	...	...	...	...	...	...	164.0	177

See Graph.

A Graph has been drawn from the figures used in Table 5 and shows very clearly the results obtained.

The total number of lactations recorded since 1936 is 50,089 and of these 77% fall in the months March to July. For the season under review, 9,065 lactations were recorded and 79% fall within the optimum period. It will be noticed that the production figure drops fairly rapidly after July and does not begin to rise again until March.

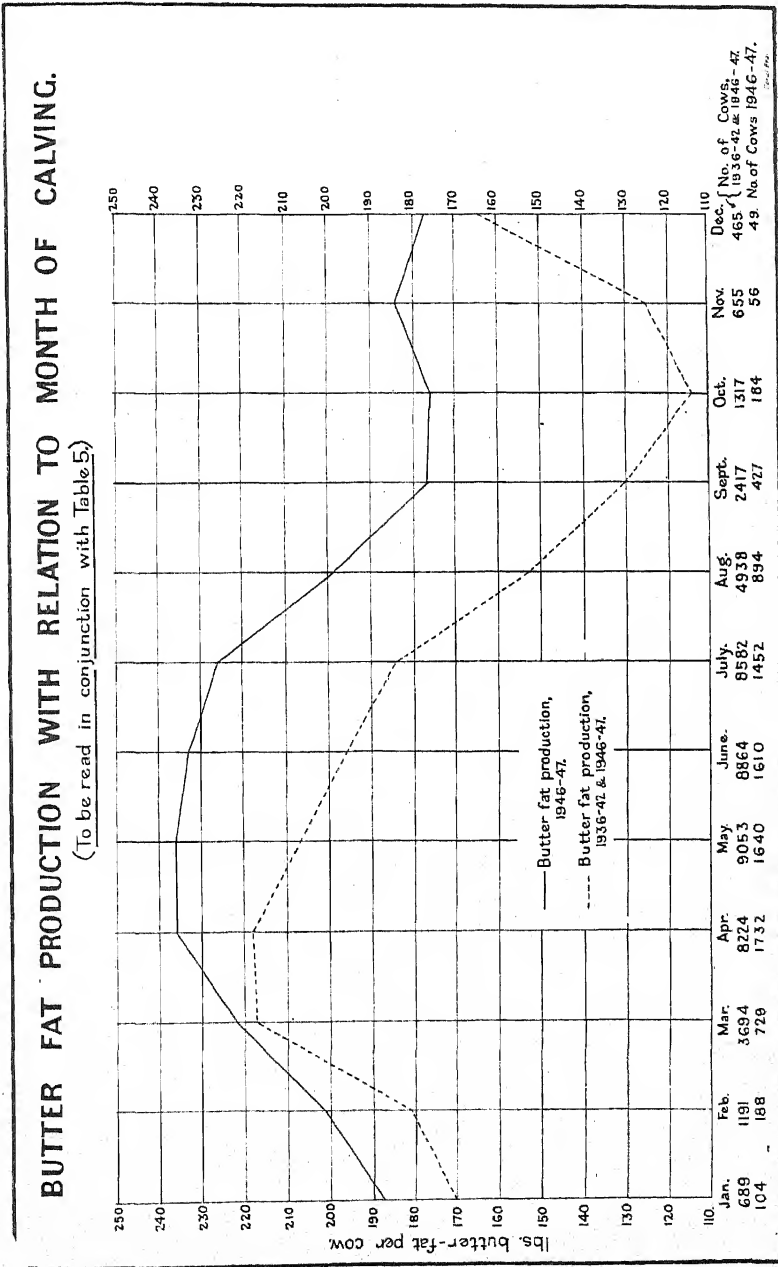


Table 6 shows the highest producing cow in each unit. These figures speak for themselves and are really meritorious.

TABLE 6.
THE HIGHEST PRODUCING COW IN EACH UNIT.

Owner.	Unit.	Cow.	Breed.	Test.	Butterfat.
				$\frac{\text{g}}{\text{lb}}$	lbs.
F. Doak	Rosa Brook ...	Maisie I. ...	A.I.S. ...	4.20	558.00
A. Millar	Forest Grove	Betty ...	Jersey ...	5.33	531.00
L. M. Temple ...	Harvey ...	Brownie ...	Jersey ...	5.90	520.00
J. Lefroy	Cowaramup, N.	Rose ...	Guernsey ...	5.41	507.00
D. Della	Pemberton ...	Sydney ...	Shorthorn x Guernsey	4.36	504.57
V. R. Bunbury ...	Metricup ...	Sadie ...	Friesian ...	4.10	493.00
D. G. Spark	Pinjarra ...	Freckles ...	Jersey ...	5.90	488.00
R. C. Eastcott ...	Waroonna ...	Posie ...	A.I.S. ...	4.10	483.00
M. L. House	Ruabon ...	Daphne ...	A.I.S. ...	4.79	481.99
O. Foan	Donnybrook ...	Brownie ...	Jersey ...	5.30	480.00
A. Millar	Cowaramup, S.	Gwen ...	Jersey ...	5.67	467.00
R. A. Clarke	Brunswick ...	Curley ...	Jersey ...	6.70	455.00†
F. R. H. Pugh ...	Mt. Barker ...	Janet ...	Jersey ...	4.70	447.00
F. Gianoni	Nannup ...	Phyllis ...	Jersey ...	5.11	441.00
J. A. Dowrick ...	Balingup ...	Brownie ...	Jersey x A.I.S.	5.30	440.00
F. Allwood	Albany ...	Dock ...	Guernsey x	5.28	439.00
G. E. Johnston ...	Margaret River	Twink ...	Jersey x Short- horn	5.13	416.00
W. Middleton ...	Denmark ...	Stumpy ...	Jersey ...	4.92	408.19
M. Kilrain	Manjimup ...	Loris ...	Shorthorn x Guernsey	4.60	406.00
J. C. Williams ...	Bridgetown ...	Ethel ...	Jersey ...	5.70	388.00*
H. Ford	Wilga ...	Jennie ...	Jersey x Short- horn	4.80	352.00*

* Eight tests only

† Seven tests only, to December.

In Table 7 is given the names of the winners of the Co-operative Dairy Farmers' Trophy in each Unit, together with the average butterfat production for the herd.

TABLE 7.
THE CO-OPERATIVE DAIRY FARMERS TROPHY.
Trophy for Highest Producing Herd in each Unit, 1946-47.

Owner.	Unit.	Butterfat Average.
		lbs.
O. Foan	Donnybrook ...	344.00
D. Della	Pemberton ...	333.87
V. R. Bunbury ...	Metricup ...	313.00
M. Brennan	Balingup ...	299.40
M. L. House	Ruabon ...	295.03
G. S. Blakie	Cowaramup, South	295.00
L. A. House	Pinjarra ...	293.00
L. M. Temple	Harvey ...	286.00
T. H. M. Lefroy ...	Cowaramup, North	282.00
W. Middleton	Denmark ...	274.33
F. R. H. Pugh	Mt. Barker ...	272.50
F. Gianoni	Nannup ...	272.00
R. J. Henderson ...	Rosa Brook ...	269.00
W. R. Foster	Waroonna ...	265.00
A. Miller	Forest Grove ...	259.00
H. G. Letchford ...	Bridgetown ...	253.57
A. R. Lang	Margaret River ...	250.14
Farr Bros.	Albany ...	250.00
V. A. Robinson	Brunswick ...	233.00
R. Wright	Wilga ...	228.00
A. J. S. Angel	Manjimup ...	226.60

These trophies have been made available through the generosity of the South-West Co-op. Dairy Farmers, Ltd., and the Great Southern Co-op. Butter Co. Ltd., with the object of stimulating interest in Grade Herd Recording and to encourage higher production herds.

For the year under review, the trophy in each unit has been awarded to the highest producing herd, but in subsequent years will be awarded to the herd showing the highest points as per an improvement schedule drawn up by the two companies mentioned and the Superintendent of Dairying.

A second trophy will be awarded after the completion of the second year's testing to the herd gaining the highest number of points in the State; whilst a major trophy is being awarded to the herd showing the highest number of points at the end of each three years testing for the whole of the State.

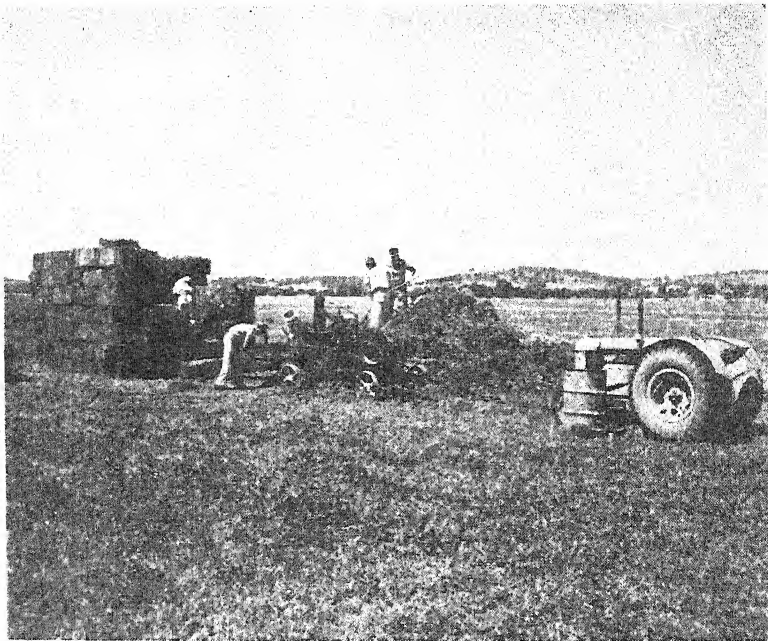
TABLE 8.
COWS COMPLETING LACTATION.

Unit.	Percentage of Cows completing Lactation.*	Butterfat Average.	Percentage of Cows completing full 273 days.	Butterfat Average.	Unit Butterfat Average.
		lbs.		lbs.	lbs.
F. Metricup ...	48	260.70	29	298.05	216.70
J. Rosa Brook ...	86	213.10	32	288.13	201.90
H. Cowaramup, South	89	211.00	36	265.84	194.90
L. Donnybrook ...	90	190.50	23	265.01	193.01
C. Harvey ...	71	197.00	20	257.59	192.65
A. Pinjarra ...	79	195.00	21	256.63	184.00
D. Brunswick ...	36	202.20	10	253.22	181.00
B. Waroona ...	72	207.20	36	251.37	198.00
G. Cowaramup, North	82	236.30	47	250.97	228.00
S. Mt. Barker ...	52	174.14	11	250.43	158.52
K. Forest Grove ...	77	184.00	20	250.01	163.30
T. Albany ...	84	161.50	21	247.83	166.00
I. Margaret River ...	51	202.00	25	241.75	187.40
P. Pemberton ...	88	159.40	20	240.84	148.37
E. Ruabon ...	73	211.60	28	240.43	201.60
M. Balingup ...	77	182.00	25	238.13	181.53
N. Bridgetown ...	92	169.10	14	235.59	167.50
W. Denmark ...	57	206.30	44	228.13	191.67
O. Manjimup ...	83	171.30	20	221.52	167.80
U. Nannup ...	97	171.60	24	220.74	170.00
R. Wilga ...	83	162.00	7	216.00	162.00
Averages ...	74	184	24	250	181

Average butterfat of cows not completing full 273 days:—157.46 lbs.

* i.e., 273 days or drying off naturally in a lesser period.

Table 8 gives a comparison between the average production of those cows which completed a full 273 days testing, those which completed lactation and those which were tested 90 days and over. The Table shows that 24% of the cows completed a full 273 days for an average production of 250 lbs. of butterfat. This figure is considerably in excess of the 184 lbs. recorded by those cows completing lactation, or the 181 lbs. shown for those testing 90 days and over. Records show that by far the greatest number of cows under review, calve before the end of July, so that it is obvious that there are a large number of cows which could be termed "short-time" cows. That is cows which will not milk or are not given the opportunity to milk for a full 273 days.



Fodder conservation in the South-West.

This is one obvious method of increasing production per cow, as it is only to be expected that a cow milking a full 9 months will produce more than if she milked for seven or eight months only and is then turned out of the herd.

For the first time under the Grade Herd Recording Scheme, particulars were collected regarding the cause of wastage in the various herds. This information is given for each Unit and for the State, in Table 9, hereunder, under the various headings.

TABLE 9.
GRADE HERD RECORDING—HERD—WASTAGE RETURN.

No.	Unit.	No. of Cows in herd.	Total Dis- posals, Wastage, etc.	Sold for Dairying Pur- poses.	Disease.					Other Causes.			
					Low Pro- duction.	Udder Troubles Mam- mitis, etc	Abortion and Sterility.	T.B.	Other Diseases.	Accident or Injury.	Old Age.	Other Causes.	Sundry Deaths.
A	B	C	D	E	F	G	H	I					
A	Pinjarra	497	61	1	35	6	...	...	...	2	2	13	2
B	Waroona	491	45	2	20	2	4	3	...	1	9	9	1
C	Harvey ...	357	19	...	7	5	4	...	...	1	...	2	...
D	Brunswick	262	24	...	13	5	2	...	...	...	...	1	3
E	Ruabon ...	390	29	5	20	1	1	...	...	...	...	...	...
F	Metreup	365	53	7	43	2	...	...	...	...	1	...	...
G	North Cowaramup	425	71	24	40	3	...	...	...	4	...	...	...
H	South Cowaramup	245	41	27	8	...	...	1	...	2	2	...	...
I	Margaret River	445	81	15	30	20	4	...	1	2	7	...	2
J	Rosa Brook	450	46	6	24	9	3	...	...	2	2	...	2
K	Forestgrove	249	29	7	19	1	...	...	...	...	...	...	...
L	Donnybrook	150	15	...	8	2	2	...	...	1	...	2	...
M	Belinup	27	6	6	...	...	...	...	...	...	...	...	...
N	Bridgetown	571	58	6	...	8	...	...	7	4	8	9	5
O	Manjimup	441	51	1	22	12	1	...	2	...	4	1	...
P	Pemberton	127	19	11	8	...	...	...	...	...	...	...	...
R	Wilga ...	482	104	3	87	9	...	...	...	...	1	...	3
S	Mt. Barker	555	77	3	36	...	1	...	...	2	3	17	7
T	Albany ...	433	67	3	43	12	...	...	...	4	2	2	1
U	Nannup ...	293	28	1	17	1	...	...	...	...	4	4	1
W	Dennmark	311	55	13	35	1	2	...	...	...	1	1	2
	Totals	7,566	979	139	536	107	24	4	11	26	40	63	29
	Percentages	...	12.98	1.84	7.08	1.41	0.32	.05	.15	.34	.51	.83	.39

It will be seen from the Table that the total wastage reported was 12·98%, and of this by far the greatest proportion was made up of animals that were quitted on account of low production. Apart from wastage due to udder troubles, losses under the other headings are very small and of little significance.

Unfortunately, information was not obtained from all testing members, and on that account the figures are not entirely satisfactory but do serve as a very good guide as to the likely causes of wastage. The overall figure of 12·98% is low when compared to New Zealand figures and those collected some years ago by this Department during the Better Dairying Competition. Both sources indicated that the yearly wastage figure ranged between 15% and 17%. It is intended to collect the above information each year throughout all units, so that within a very short period information of a reliable character will be available under all headings.



The herd at pasture. A familiar scene in the dairy areas.

The following Tables 10 to 13, show the leading herds in the groups of under 20 cows; 20-30 cows; 31 to 50 cows and over 50 cows. Previously these Tables have proved of interest to all members.

TABLE 10.
LEADING HERDS OF LESS THAN 20 COWS.

Name of Owner.	Unit.	No. of Cows.	Breed.	Butter Fat Average.
				lbs.
D. H. Bell	Metricup	13	A.I.S.	312·54
G. Barnsby	Pemberton	14	Guernsey	300·35
L. A. House	Pinjarra	18	Jersey	293·00
L. M. Temple	Harvey	17	Jersey	286·00
G. M. Cabassi	Pemberton	14	Guernsey	276·06
R. J. Henderson	Rosa Brook	15	Guernsey	269·00
H. Lewis	Metricup	16	Jersey x Shorthorn	268·00
H. Hawkesford	Cowaramup, North	11	Jersey x Shorthorn	262·00
F. Doak	Rosa Brook	18	Mixed	260·00
G. Snaeddon	Rosa Brook	15	Shorthorn	250·00

TABLE 11.
LEADING HERDS OF 20-30 COWS.

Name of Owner.	Unit.	No. of Cows.	Breed.	Butter Fat Average.
				lbs.
O. Foan	Donnybrook ...	24	Jersey	344.00
D. Della	Pemberton ...	21	Mixed	333.87
M. Brennan	Balingup	27	Jersey x Guernsey	299.40
M. L. House	Ruabon	20	Shorthorn	295.03
G. S. Blakie	Cowaramup, South	30	Shorthorn	295.00
D. G. Spark	Pinjarra	29	Jersey	288.00
N. L. Murdock	Metrieup	21	Jersey	288.00
T. H. M. Lefroy	Cowaramup, North	25	Shorthorn x Jersey	282.00
J. Lefroy	Cowaramup, North	29	Jersey and Guernsey	281.00
W. Middleton	Denmark	23	Jersey	274.33
A. Millar	Cowaramup, South	29	Jersey	265.00
R. W. Gregson	Forest Grove ...	24	Guernsey	259.00
S. Pedretti	Nannup	21	Jersey x Shorthorn	259.00
J. A. Dowrick	Balingup	27	Jersey x Guernsey	258.00
A. R. Lang	Margaret River ...	29	Mixed	251.40
Farr Bros.	Albany	30	Guernsey	250.00

TABLE 12.
LEADING HERDS OF 31-50 COWS.

Name of Owner.	Unit.	No. of Cows.	Breed.	Butter Fat Average.
				lbs.
G. Layman	Donnybrook ...	44	Jersey	292.00
S. C. Maidment	Balingup	41	Jersey x Shorthorn	278.30
W. B. and R. L. Blakie ...	Cowaramup, North	40	Jersey	277.00
F. R. H. Pugh	Mt. Barker	47	Jersey x	272.50
F. Gianoni	Nannup	39	Jersey and Jersey x Shorthorn	272.00
W. R. Foster	Waroona	32	Jersey and Shorthorn x	265.00
A. G. Thompson	Ruabon	43	Jersey	260.30
D. O. Briggs	Metrieup	31	Friesian x	258.26
E. L. Brockman	Ruabon	39	A.I.S.	256.51
H. G. Letchford	Bridgetown	35	Jersey	253.50

TABLE 13.
LEADING HERDS OF 51 OR MORE COWS.

Name of Owner.	Unit.	No. of Cows.	Breed.	Butter Fat Average.
				lbs.
V. R. Bunbury	Metrieup	67	Fresian and Short-horn	313.00
A. Millar	Forest Grove ...	51	Jersey and Guernsey	259.00
J. Torrent	Ruabon	54	Shorthorn and Jersey	234.93
E. B. and H. M. McNeill ...	Waroona	67	Shorthorn x	228.00
R. A. and J. A. Jackson ...	Rosa Brook	56	Shorthorn x	219.94
T. Hick	Cowaramup, North	61	Mixed	219.00
R. Beacham	Pinjarra	57	Shorthorn x Jersey	211.00
L. J. Hooker	Harvey	52	Shorthorn	209.00
H. J. Mullins	Pinjarra	56	A.I.S.	207.00
J. Salerian	Waroona	74	Jersey x and Red Pole	200.00

In previous reports, a list of "Proved Bulls" has been published and this information has once more been carefully compiled.

TABLE 14.
BULLS WITH 6 OR MORE DAUGHTERS COMPLETING LACTATION—NO ALLOWANCE FOR AGE.

Name of Bull.	Breed.	No. of Daughters.	Average Butterfat Production.	Unit.	Owner.	Age Bull.
Prince Peep	Jersey	6	378.50	Donnybrook	O. Foan	13
Greenmount Bright Lad	do.	6	369.50	Pinjara	D. G. Spark	10
Hopelands Pattern	do.	6	340.50	Donnybrook	G. Layman	7
Sophie's Monarch (Grade)	do.	6	334.00	Donnybrook	O. Foan	7
Navua Coronation Star	do.	8	328.50	Harvey	L. M. Temple	10
Greenmount Golden Victory 2nd	do.	6	306.50	Pinjara	L. A. House	11
Navua Royal Star	do.	6	304.66	Harvey	Mrs. A. G. Eckersley	10
Hopelands Bidomak	do.	6	295.00	Donnybrook	G. Layman	8
Frisky Lad (Grade)	do.	12	293.70	Bridgetown	H. G. Letchford	Dead
Moorelands Julian	do.	9	293.55	Penberton	J. J. Littlefair	13
Camden Photo	do.	10	291.60	Cowaramup, South	G. V. Crooke	10
Crantook Napoleon's Masterpiece	do.	10	289.90	Denmark	W. Middleton	9
Radyr Park's Spotted Boy	do.	10	278.30	Cowaramup, South	A. Millar	12
Fairfield's Golden Chief	do.	13	271.30	Bridgetown	H. G. Letchford	11
Grantham's Oxford Altitude	do.	6	253.83	Donnybrook	A. C. Frost	10
Radyr Park Golden Lad	do.	8	249.00	Bridgetown	V. Dezotti	Dead
Brookvale Orphan	do.	6	244.10	Bridgetown	J. C. Williams	Dead
Ferdinand (Grade)	do.	11	241.50	Donnybrook	A. Clifford & Sons	5
Walgetts Masterpiece Beau	do.	18	241.10	Bridgetown	J. C. Williams	Dead
Grantham's Easter Monarch	do.	6	238.33	Donnybrook	G. V. Mitchell	13
Colmyn Golden III	do.	6	238.10	Mcintup	A. S. Mutimer	9
Walgett Handsome Beau	do.	10	235.00	Donnybrook	W. F. Dilley	12
Maxon Noble	do.	6	228.83	Margaret River	W. J. Rowe	11
The Towers Empire Prince	do.	6	225.00	Donnybrook	R. Benson	11
Moorlands Gold Duke	do.	6	220.00	Cowaramup, South	A. Millar	7
Grassvale Prince Charlie	do.	6	207.87	Marybrook	A. J. Bell	Dead
Walgetts Guardian	do.	8	203.88	Nannup	J. T. McKittick	8
Colmyn White Sox	do.	8	203.00	Donnybrook	G. L. Henfry	14
Cestrefeld Bonnie Charlie	do.	6	199.00	Manjimup	W. J. Morgan	9
Kapara Emblem	do.	12	194.59	Denmark	J. Stephens	9
Popeye (Grade)	do.	17	189.33	Donnybrook	P. Proctor	9

TABLE 14—continued.

BULLS WITH 6 OR MORE DAUGHTERS COMPLETING LACTATION—NO ALLOWANCE FOR AGE.

Name of Bull.	Breed.	No. of Daughters.	Average Butterfat Production.	Unit.	Owner.	Age Bull.
The Wold's Easter Prince	Jersey	12	lbs. 187.50	Donnybrook	W. J. Sears	11
Pluto	do.	8	185.70	Cowaramup, South	F. Campbell	Dead
Marbelp Gay Lad	do.	7	184.29	Margaret River	W. J. Rowe	9
The Tower's Bunt	do.	6	177.33	Donnybrook	E. J. Kemp	7
The Wold's Starbright Prince	do.	6	171.15	Donnybrook	N. G. Baker	11
Springview Pretty Boy	do.	9	164.44	Balingup	S. G. Guest	8
Grade Bull	do.	6	162.33	Donnybrook	J. T. Mance	6
Grangelea Admiral II	do.	15	162.13	Ruabon	G. F. Stacey	15
Camden Hiawatha	do.	6	140.83	Donnybrook	G. Creyk	5
Grafton Melrose (Grade)	do.	10	137.40	Bridgetown	P. W. Letchford	Dead
Brookvale Digger	do.	12	130.00	Bridgetown	G. Roberts	Dead
Leyland's Foot	A.I.S.	6	332.17	Pinjarra	H. J. Mullins	13
Summerlea Cassidy	do.	11	297.64	Ruabon	J. J. Torrent	7
Newstead Royal Sun	do.	6	288.83	Metrioup	D. H. Bell	7
Tregony Laddie	do.	10	269.70	Nannup	F. Gianoni	Dead
Ilgrip Humber	do.	8	256.88	Donnybrook	L. M. Weatherlea	10
Summerlea Robin Hood	do.	6	248.17	Ruabon	G. Layman	9
Brackenhurst Marquis	do.	10	244.40	Cowaramup, South	A. W. and W. L. Langley	11
Westby Commander	do.	15	238.26	Denmark	F. C. Smith	9
Telyarup Duke	do.	11	236.82	Margaret River	L. L. Hargrave	12
Brackenhurst Reward	do.	11	233.45	Pinjarra	W. H. George	11
Plenarbor Barney	do.	6	233.33	Ruabon	H. J. Mullins	6
Glanavon Pilot	do.	16	233.31	Cowaramup, North	E. L. Brockman	7
Summerlea Alphonse	do.	9	231.66	Donnybrook	E. Clayton	Dead
Fairbridge Prince	do.	6	221.50	Cowaramup	M. C. Fry & Sons	14
Tipperary Victor	do.	9	213.00	Warcoona	H. D. Hardy	Dead
Summerlea Nought 1	do.	17	203.47	Cowaramup, North	Tansell & Lewis	Dead
Woorloo Rose III Guardian	do.	20	196.70	Manjimup	W. Hamilton	11
Brackenhurst Sailor	do.	15	196.70	Bridgetown	E. A. Roberts	11
Glanavon Neon	do.	9	191.60	Bridgetown	E. A. Roberts	6
Ilgrip Surprise Lindsay	do.	8	187.13	Metrioup	W. L. Still	6

TABLE 14—continued.
BULLS WITH 6 OR MORE DAUGHTERS COMPLETING LACTATION—NO ALLOWANCE FOR AGE.

Name of Bull.	Breed.	No. of Daughters.	Average Butterfat Production.	Unit.	Owner.	Age Bull.
Brackenhurst Advocate ...	A.I.S.	13	180.50	Bridgetown	W. K. Walter	12
Haddon Emblem ...	do.	8	162.70	Bridgetown	H. E. Gifford	8
Brackenhurst Reward II	do.	6	161.50	Bridgetown	W. K. Walter	10
Narracoorte Pal ...	do.	6	161.10	Bridgetown	L. Fellowes	6
Brackenhurst Roger ...	do.	8	143.70	Bridgetown	W. K. Walter	6
Summerlea Songster ...	do.	6	139.83	Donybrook	M. G. Fry & Sons	8
Glanavon Victory ...	do.	6	138.00	Manjimup	E. W. Morey	10
Summerlea Embresses Reward	do.	8	161.70	Manjimup	C. H. J. Hastie	7
Riverside Damon	Queensley	9	309.11	Albany	F. Allwood	12
Rutherford Daffodil's Prosper	do.	6	305.00	Albany	Goldsmith & Stevens	11
Denmark Dawn's Goldseeker	do.	6	297.00	Albany	Farr Bros.	10
Muresk Justice ...	do.	8	266.38	Rosa Brook	H. Harrison	Dead
Denmark Bonnie's Ace	do.	8	266.00	Denmark	R. B. Fowler	8
Koojan Ace's Success	do.	11	255.91	Warcona	E. Marston	14
Denmark Anthony	do.	6	245.17	Albany	F. Allwood	12
Drakesbrook Benefactor	do.	11	236.82	Warcona	A. R. Tester	13
Rosella's President	do.	8	234.63	Rosa Brook	J. M. Schipp	8
Lansdowne Aristocrat	do.	6	233.17	Pinjara	H. Wegner	10
Rosella Majesty ...	do.	6	229.66	Margaret River	P. E. Jones	9
Denmark Dame's Boy	do.	8	211.63	Denmark	W. G. Corbin	17
Muresk Commander	do.	6	202.83	Margaret River	G. Zani	12
Redhouse Birdie's Freedom	do.	12	197.20	Cowaramup, South	A. L. Gallies	10
Braesides Robin ...	do.	7	193.14	Pemberton	B. A. Rice	13
Lansdowne Dido ...	do.	12	177.00	Donybrook	E. J. Kemp and H. M. Bradshaw	11
Drakesbrook Kingfisher	do.	6	168.50	Warcona	A. R. Tester	12
Braeside Governor II.	do.	9	165.50	Bridgetown	L. Fellowes	8
Lansdowne Golden Dividend	do.	6	162.67	Pinjara	H. Wegner	5
Sir James (Grade)	do.	23	142.30	Denmark	W. J. Sutton	12
Denmark Damascus	do.	8	120.00	Manjimup	F. S. Little	Dead
Hamel Boy	Red Poll	7	304.71	Cowaramup	W. B. & R. L. Blakeie	Dead
Hilton Bob	do.	7	140.30	Bridgetown, North	L. Machin	14
King Griselda	Friesian	14	259.90	Cowaramup, South	L. F. Arthur	Dead

The table gives the name of each bull which has had six or more daughters tested and completing lactation, the average production of the daughters, without allowance for age, the name of the owner of the bull and the approximate age of the animal where still alive.

AVERAGE PRODUCTION OF HERDS IN ALL UNITS.

Particulars of the Production of each herd in each unit under test for the year 1946-47, are listed hereunder.

Balingup "M."				Brunswick "D."			
	No.	Milk	Butter-		No.	Milk	Butter-
	of	fat	fat		of	fat	fat
	Cows.	Av.	Av.		Cows.	Av.	Av.
		gals.	lbs.			gals.	lbs.
M. Brennan ...	27	656	299.4	V. A. Robinson ...	30	490	233
S. C. Maidment ...	41	663	278.3	R. C. Gardiner ...	24	512	224
J. A. Dowrick ...	27	567	258.7	D. B. Rose ...	45	439	223
Herd I ...	21	486	222.3	Herd I ...	39	422	219
" N ...	37	415	216.9	" N ...	36	502	213
" A ...	27	457	210.3	" J ...	30	328	203
" U ...	31	459	201.0	" C ...	13	408	186
" T ...	48	510	191.7	" G ...	60	383	184
" O ...	32	429	177.3	" P ...	27	406	168
" V ...	60	454	173.8	" H ...	34	357	144
" C ...	29	404	173.8	" A ...	48	332	142
" H ...	20	354	171.6	" O ...	20	350	137
" S ...	54	518	169.9	" M ...	22	255	106
" D ...	31	335	161.6	" K ...	33	288	106
" R ...	41	316	157.9				
" K ...	30	351	157.5				
" Y ...	47	310	149.6				
" B ...	15	304	144.4				
" Z ...	34	293	139.1				
" X ...	20	317	129.9				
" P ...	40	325	124.2				
" F ...	21	247	103.0				
" G ...	9	209	95.4				
Wilga "R."				Mt. Barker "S."			
	No.	Milk	Butter-		No.	Milk	Butter-
	of	fat	fat		of	fat	fat
	Cows.	Av.	Av.		Cows.	Av.	Av.
		gals.	lbs.			gals.	lbs.
R. Wright ...	14	551	228	F. R. H. Pugh ...	47	654	272.50
J. Charteris ...	21	473	218	Cluett & Sons ...	20	506	229.10
H. Ford ...	21	431	203	Pardelup Prison Farm ...	24	581	215.41
Herd D ...	25	417	199	Herd E ...	27	436	194.00
" G ...	49	382	185	" F ...	19	455	193.40
" K ...	35	351	174	" W ...	20	439	190.90
" V ...	13	402	174	" P ...	21	421	185.60
" N ...	5	397	174	" A ...	21	364	168.50
" E ...	8	353	168	" B ...	39	380	161.70
" H ...	6	316	166	" N ...	13	392	159.80
" P ...	19	380	164	" K ...	53	392	155.62
" U ...	23	333	159	" M ...	30	345	152.40
" J ...	20	318	153	" V ...	17	345	146.29
" B ...	24	342	154	" Q ...	32	351	144.09
" M ...	32	361	150	" I ...	16	330	143.12
" S ...	21	311	150	" G ...	37	238	137.90
" Q ...	42	388	143	" O ...	34	314	136.55
" W ...	6	303	125	" C ...	14	325	131.30
" L ...	36	276	119	" R ...	15	301	126.30
" C ...	25	237	102	" T ...	26	243	103.88
" X ...	10	236	90	" S ...	17	240	96.40
				" L ...	27	208	91.80
				" J ...	44	224	80.84

Average Production of all Units—continued.

Pemberton "P."			Harvey "C."					
	No.	Milk	Butter-		No.	Milk	Butter-	
	Cows.	Av.	fat		Cows.	Av.	fat	
			Av.				Av.	
		gals.	lbs.			gals.	lbs.	
D. Della ...	21	718	333.87	L. M. Temple ...	17	543	286	
G. Barnsby ...	14	522	300.35	Mrs. A. G. Eckersley ...	30	466	238	
G. M. Cabassi ...	14	684	276.06	W. K. Barnes ...	47	546	219	
Herd A ...	23	495	230.42	Herd Q ...	16	479	214	
" M ...	24	425	190.23	" B ...	38	549	211	
" D ...	19	415	187.96	" G ...	52	495	209	
" K ...	9	439	183.40	" H ...	50	463	204	
" P ...	20	386	181.33	" M ...	58	530	198	
" O ...	15	358	172.38	" C ...	35	394	181	
" G ...	20	353	171.75	" L ...	36	419	175	
" J ...	11	341	160.76	" D ...	38	422	175	
" F ...	22	350	157.30	" P ...	32	338	162	
" T ...	26	356	153.65	" N ...	30	307	154	
" C ...	17	286	153.12	" I ...	34	321	146	
" L ...	17	337	143.64	" J ...	25	248	117	
" S ...	29	300	140.87					
" Q ...	20	297	138.75					
" I ...	16	347	138.23					
" R ...	16	282	136.19					
" U ...	16	292	127.04					
" N ...	13	225	93.33					
" V ...	25	115	90.93					

Margaret River "I."			Ruabon "E."					
	No.	Milk	Butter-		No.	Milk	Butter-	
	Cows.	Av.	fat		Cows.	Av.	fat	
			Av.				Av.	
		gals.	lbs.			gals.	lbs.	
A. R. Lang ...	29	546	250.14	M. L. House ...	20	772	295.03	
P. E. Jones ...	16	513	243.06	A. G. Thompson ...	43	578	260.30	
G. E. Johnston ...	16	455	226.30	E. L. Brockman ...	39	686	256.51	
Herd L ...	16	502	226.10	Herd D ...	54	555	234.93	
" A ...	39	541	219.10	" Q ...	23	499	218.36	
" O ...	18	443	215.90	" R ...	35	504	214.71	
" B ...	19	411	201.70	" O ...	48	499	213.83	
" R ...	20	425	196.60	" E ...	27	494	210.24	
" W ...	16	423	196.30	" P ...	23	477	203.71	
" P ...	45	428	194.20	" I ...	41	500	201.28	
" C ...	30	459	194.06	" A ...	27	434	199.66	
" S ...	21	457	190.00	" N ...	27	475	192.11	
" E ...	23	426	189.60	" G ...	50	406	177.67	
" X ...	31	398	188.30	" B ...	60	435	177.55	
" I ...	34	410	185.90	" H ...	26	386	164.32	
" Q ...	22	384	167.60	" L ...	34	395	162.40	
" K ...	24	379	162.60	" J ...	31	368	155.16	
" H ...	26	405	161.90	" K ...	40	354	145.48	
" J ...	14	325	143.00	" S ...	21	328	137.45	
" M ...	20	292	139.60					
" D ...	47	312	137.70					
" Z ...	23	341	130.00					

Average Production of all Units—continued.

Waroona "B."				Bridgetown "N."			
	No.	Milk	Butter-		No.	Milk	Butter-
	Cows.	Av.	fat		Cows.	Av.	fat
			Av.				Av.
		gals.	lbs.			gals.	lbs.
W. R. Foster ...	32	606	265	H. G. Letehford ...	35	571	253.57
R. C. Eastcott ...	30	526	241	V. Dezotti ...	42	497	232.80
E. B. & H. H. McNeill	67	539	228	J. C. Williams ...	46	446	216.90
Herd C ...	28	501	220	Herd U ...	17	412	196.60
" F ...	28	494	218	" E ...	22	432	190.00
" L ...	37	468	209	" R ...	25	492	188.30
" K ...	30	491	204	" H ...	42	430	182.00
" M ...	74	423	200	" O ...	37	400	180.70
" G ...	29	441	194	" K ...	34	396	158.40
" E ...	31	401	186	" C ...	27	336	153.70
" D ...	30	404	185	" Q ...	61	396	152.50
" B ...	26	424	183	" G ...	48	388	151.80
" I ...	35	421	181	" A ...	12	319	148.30
" Q ...	28	419	168	" L ...	36	330	147.50
" P ...	41	337	134	" M ...	17	364	140.80
" A ...	20	213	92	" F ...	33	312	139.30
				" T ...	34	328	137.50
				" P ...	19	285	126.70
				" J ...	35	321	125.40
				" B ...	34	266	111.20
				" X ...	14	280	106.40
Pinjarra "A."				Manjimup "O."			
	No.	Milk	Butter-		No.	Milk	Butter-
	Cows.	Av.	fat		Cows.	Av.	fat
			Av.				Av.
		gals.	lbs.			gals.	lbs.
L. A. House ...	18	595	293	A. J. S. Angel ...	35	495	226.60
D. G. Spark ...	29	585	288	M. Kilrain ...	23	516	219.90
V. A. Humphrey ...	32	588	236	A. C. Head ...	21	462	208.20
Herd M ...	23	543	226	Herd N ...	26	496	194.90
" A ...	32	490	213	" T ...	22	402	192.50
" Q ...	57	504	211	" B ...	32	453	189.30
" B ...	56	564	207	" F ...	10	414	188.70
" R ...	29	422	200	" W ...	34	390	177.06
" I ...	34	379	178	" G ...	28	460	174.10
" P ...	27	428	162	" E ...	22	380	169.80
" C ...	35	435	159	" S ...	37	367	167.60
" J ...	24	357	154	" J ...	28	371	165.80
" O ...	56	323	149	" Y ...	26	379	160.60
" D ...	30	382	147	" U ...	49	391	159.50
" G ...	26	342	145	" P ...	26	454	157.90
" K ...	40	292	143	" D ...	14	351	157.00
" N ...	23	347	134	" K ...	39	358	149.80
" H ...	25	253	110	" A ...	29	322	142.10
				" M ...	36	329	136.20
				" X ...	35	334	122.20
				" L ...	16	287	118.90
				" R ...	15	275	118.60

Average Production of all Units—continued.

Denmark "W."	No. of Cows.	Milk Av.	Butter- fat Av.	Metricup "F."	No. of Cows.	Milk Av.	Butter- fat Av.
		gals.	lbs.			gals.	lbs.
W. Middleton	23	537	274.33	V. R. Bunbury	67	776	313.00
H. S. Redman	22	485	238.99	D. H. Bell	13	759	312.54
R. Fowler	17	471	233.51	N. L. Murdock	21	566	288.00
Herd J	18	558	225.53	Herd M	16	588	268.06
" E	31	567	223.97	" A	31	589	258.26
" C	12	503	218.67	" S	24	471	248.50
" P	24	469	209.61	" B	25	487	232.80
" R	17	401	197.49	" C	23	505	232.74
" W	24	407	192.75	" E	17	477	215.94
" Z	19	410	191.15	" O	23	472	207.70
" G	36	436	190.25	" T	48	440	202.02
" L	21	373	185.55	" G	26	415	201.50
" N	38	386	170.51	" D	21	452	200.43
" M	25	385	162.40	" V	17	389	194.06
" B	8	367	158.13	" H	31	379	181.51
" S	13	327	152.41	" U	32	375	175.22
" D	19	332	145.55	" I	26	341	155.65
" T	7	331	143.90	" J	14	318	149.00
" F	34	302	138.53	" P	16	289	140.31
" Q	13	303	127.07	" Q	10	266	128.20
				" K	15	266	127.07
				" W	11	264	126.72
				" F	14	257	119.14

Nannup "U."	No. of Cows.	Milk Av.	Butter- fat Av.	Forest Grove "K."	No. of Cows.	Milk Av.	Butter- fat Av.
		gals.	lbs.			gals.	lbs.
F. Gianoni	39	599	272	A. Millar	51	516	259
S. Pedretti	21	611	259	R. W. Gregson	24	546	259
N. Hutchins	29	542	244	J. H. Oldfield	39	530	248
Herd B	38	472	201	Herd C	19	504	246
" L	20	392	197	" S	26	500	223
" D	35	485	190	" M	23	451	216
" E	39	422	188	" V	37	409	208
" N	15	404	185	" N	53	435	198
" G	22	389	169	" F	17	421	190
" F	42	426	168	" H	18	359	173
" T	26	355	166	" J	27	370	165
" H	29	354	157	" O	39	362	164
" S	40	396	154	" E	39	371	162
" M	28	325	153	" B	38	343	157
" X	52	367	149	" G	16	343	155
" P	26	372	144	" T	23	316	147
" V	14	301	140	" Y	36	342	140
" R	24	359	139	" P	36	326	137
" I	23	300	132	" R	32	258	135
" J	48	274	128	" Q	24	311	132
" W	14	281	119	" Z	14	279	126
" Y	29	328	118	" X	28	261	106
" O	22	244	102	" L	1	213	76
				" X	7	106	68
				" W	14	104	51

Average Production of all Units—continued.

Albany "T."	No. of Cows.	Milk Av. gals.	Butter- fat Av. lbs.	Rosa Brook "J."	No. of Cows.	Milk Av. gals.	Butter- fat Av. lbs.
Farr Bros. ...	30	536	250	R. J. Henderson ...	15	555	269
F. V. Hortin ...	25	586	237	F. Doak ...	18	552	260
F. Allwood ...	29	490	230	G. Snedden ...	15	568	250
Herd K ...	21	486	229	Herd B ...	26	527	245
" U ...	14	498	219	" R ...	35	530	235
" G ...	39	447	199	" O ...	16	466	229
" B ...	29	414	189	" U ...	56	489	220
" A* ...	17	409	185	" C ...	24	470	218
" X ...	8	449	174	" K ...	37	490	216
" M ...	24	367	166	" L ...	24	457	212
" V ...	13	390	166	" S ...	49	466	201
" E ...	8	370	161	" X ...	24	446	197
" H ...	42	365	156	" E ...	27	433	196
" N ...	15	380	156	" Q ...	34	400	192
" S ...	22	340	146	" V ...	19	390	189
" Z ...	26	317	135	" A ...	22	456	188
" D ...	22	363	133	" H ...	32	409	182
" O ...	27	290	124	" D ...	24	388	179
" Y ...	22	319	101	" P ...	28	412	178
" P ...	30	223	99	" F ...	30	437	174
" R ...	25	214	91	" G ...	37	365	166
" J ...	17	176	69	" I ...	14	348	164

* Inverted.

Cowaramup, North "G."	No. of Cows.	Milk Av. gals.	Butter- fat Av. lbs.	Cowaramup, South "H."	No. of Cows.	Milk Av. gals.	Butter- fat Av. lbs.
T. H. M. Lefroy ...	25	625	282	G. S. Blaikie ...	30	688	295
J. Lefroy ...	27	589	281	A. Millar ...	29	523	265
W. B. & R. L. Blaikie	40	569	277	L. F. Arthur ...	22	568	248
Herd Z ...	11	523	262	Herd C ...	26	492	243
" C ...	24	545	245	" B ...	48	591	238
" R ...	14	572	244	" K ...	26	505	238
" F ...	23	541	237	" E ...	23	482	225
" S ...	16	455	234	" N ...	28	478	215
" A ...	31	471	231	" I ...	20	509	210
" K ...	27	538	230	" D ...	40	506	199
" W ...	34	508	229	" O ...	15	426	186
" G ...	19	509	226	" F ...	31	368	184
" P ...	21	471	223	" H ...	48	374	172
" E ...	26	467	221	" J ...	30	486	165
" Y ...	61	469	219	" M ...	21	354	159
" H ...	20	435	209	" Q ...	20	217	159
" M ...	24	439	203	" P ...	24	323	146
" D ...	33	501	196				
" X ...	40	450	192				
" J ...	18	395	180				
" O ...	12	252	114				

Donnybrook "L."	No. of Cows.	Milk Av. gals.	Butter- fat Av. lbs.	Donnybrook "L."— continued.	No. of Cows.	Milk Av. gals.	Butter- fat Av. lbs.
O. Foan ...	24	691	344	Herd X ...	39	390	173
G. Layman ...	44	557	292	" J ...	21	353	173
A. Clifford & Sons ...	21	496	233	" P ...	16	338	170
Herd C ...	25	425	223	" T ...	16	323	158
" M ...	19	469	220	" F ...	21	347	155
" A ...	24	418	209	" K ...	26	307	152
" D ...	27	415	208	" W ...	24	299	145
" S ...	18	425	196	" E ...	30	273	141
" V ...	38	493	193	" R ...	15	307	135
" B ...	40	397	181	" G ...	21	265	129
" H ...	33	395	176	" O ...	16	257	128

LOCALLY GROWN LEGUMINOUS SEEDS.

THEIR COMPOSITION AND FOOD VALUE.

By

L. C. SNOOK,

Animal Nutrition Officer.

There is now a world-wide shortage of protein-rich foodstuffs and this shortage is likely to persist for some years. Poultry farmers and dairy men in this State have already felt the effect of this shortage and additional supplies of protein-rich food would be very welcome. The position could be made much easier by the more extensive growth and use of leguminous seeds. From time immemorial beans, peas and similar pulses have formed an important part in the diet of man and beast. If leguminous seeds could be grown extensively in this State they would be of great value to stock of all types. This paper has therefore been prepared to draw attention to the composition of locally grown leguminous seeds and to emphasise their value to the farmer.

Material Used.—Since 1932, the author has at various times analysed samples of leguminous seeds. The Government Chemical Laboratories have likewise at various times analysed samples submitted by the Department of Agriculture. These analyses indicate that some Western Australian seeds are outstanding in nutritional value and it is important that this fact should receive publicity. For this reason the various data have been sorted out and listed in the various appendices to this paper.

As the samples were collected over a period of years from farmers throughout the agricultural areas, the figures quoted should give an index of the variability (if any) found in the seeds of the same species when grown in different years or in different places. It will be seen from the appendices that the compositions are remarkably uniform and the average values recorded in Table I. would seem to give a very reliable indication of the composition of the various species wherever grown in South-West Australia.

The various legumes will be discussed in the order in which they are listed in Table I, page 301.

FIELD PEAS. (*Pisum arvense*.)

Field peas have been grown extensively for many years in Western Australia and in favoured areas have proved a very profitable crop, particularly for fattening late lambs or building up pregnant ewes during the summer months. For this purpose the pea crop, generally sown with oats, is allowed to mature, the stock being admitted to eat the dry seeds and plant material, when other grazing has deteriorated in nutritive value. Obviously the seeds constitute the most nutritious portion of the crop. Two major disadvantages limit the growth of field peas for this purpose: the plants do not readily recover if grazed while green and the seeds often become heavily infested with pea-weevil. Pea crops are also subject to other pests such as black stem rot and the attacks of cut worm. The analytical data in this paper disclose another disadvantage; the seeds of the field pea contain considerably less crude protein than other leguminous seeds which could be grown.

TABLE I.

LEGUMINOUS SEEDS.

Average Composition when grown in Western Australia.

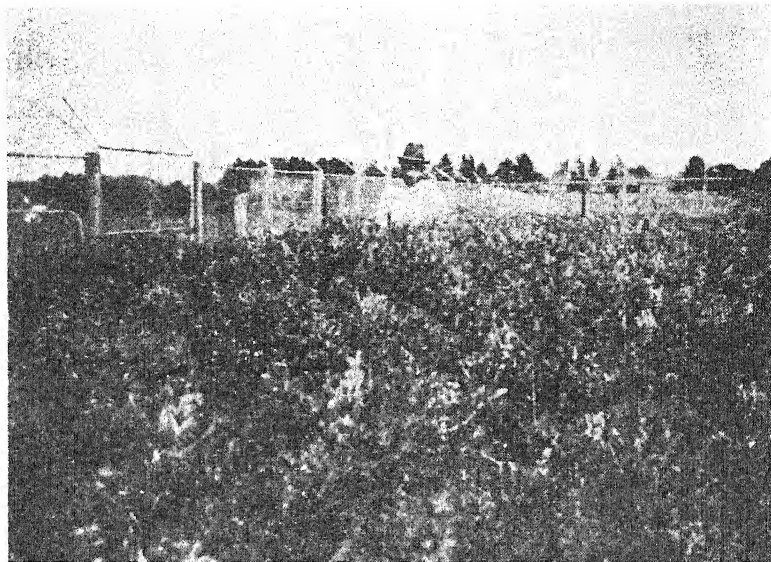
Legume.	Number of Samples Analysed.	Crude Protein (N x 6.25).	Fat (Ether Extract)	Crude Fibre.	Carbo-hydrate (N free extract).	Ash	Calcium.	Phosphorus (P)
Field Pea—"White Brunswick" (<i>P. arvense</i>) ...	8	23.6	1.7	5.8	65.7	3.2	0.07	0.40
West Aust. Blue Lupin (<i>L. varius</i>) ...	15	34.0	2.5	19.5	40.8	3.2	0.16	0.39
New Zealand Blue Lupin (<i>L. angustifolius</i>) ...	4	36.3	3.6	13.6	43.8	2.7	0.19	0.27
Yellow Lupin (<i>L. luteus</i>)	5	42.6	4.4	16.2	32.9	3.9	0.27	0.42
Tangier Pea (<i>L. tingitanus</i>) ...	6	40.4	1.1	5.2	48.7	4.6	0.13	0.33
VETCHES GROWN AT MURESK—1945.								
Palestinian Vetch (<i>V. dasycarpa</i>) ...	1	32.2	1.0	5.4	58.9	2.5	0.15	0.30
<i>V. monantha</i> ...	2	31.8	1.1	3.4	60.1	3.6	0.12	0.47
Muresk Vetch (<i>V. sativa</i>)	1	30.2	1.0	6.0	58.2	4.6	0.21	0.46
Avondale Vetch (<i>V. sativa</i>) ...	1	30.2	1.2	3.8	62.4	2.4	0.11	0.27
Chickling Vetch (<i>L. sativus</i>) ...	1	30.1	1.0	6.3	57.4	5.2	0.15	0.44
<i>L. ochris</i> ...	2	27.6	1.6	6.0	61.5	3.3	0.17	0.36
FOR COMPARISON.								
F.A.Q. Wheat grain ...	7	11	1.5	2	84	1.5	0.04	0.24
Linseed Meal ...	...	33	4.4	11	44.8	6.8	0.05	1.25

In Appendix I., the analyses of eight sample of "White Brunswick" field peas are recorded. There is a striking uniformity in composition, despite the fact that the samples were collected over a period of years from districts with markedly different climatic conditions. The lack of variation in protein content is particularly interesting—six of the eight samples contained between 22 and 23% crude protein in the dry matter—in view of the fact that the protein content of cereal grains varies enormously from district to district ("Nabawa" wheat grown at Merredin over five years, averaged 15% crude protein in the dry matter compared with the 9% found in "Nabawa" wheat grown at Wongan Hills during the same years. Snook, 1939.)

At the present time farmers are particularly concerned with the protein, phosphorus and calcium contents of feeding stuffs. It can be seen from Table I. that field peas are quite a good source of crude protein containing about 23% compared with the 11% present in F.A.Q. wheat (average over seven years). The protein in peas has always been accepted as being of excellent quality and although of recent years workers have stressed that certain leguminous seeds are lacking in essential sulphur-containing amino-acids (Block & Mitchel, 1946; Lugg & Weller, 1944) the fact remains that the seeds of the field pea are a very valuable supplement to stock on dry feed. The only point at issue is: can peas be replaced by a better legume.

Pea seeds are a good source of phosphorus, containing more than half as much again (0·40% P in the dry matter) as F.A.Q. wheat (0·24% P in dry matter).

It is interesting to note that pea seeds are deficient in calcium, containing only 0·07%, which is very little better than the average cereal grain. Fortunately leguminous roughage is particularly rich in calcium, this being of particular value to high producing dairy cows for that reason.



West Australian Blue Lupins, September, 1947.

Growing on unfertilized sandy soil at Animal Health Laboratory, Nedlands.

WEST AUSTRALIANS BLUE LUPINS (*Lupinus varius*).

The use of lupin seed as an important sheep food is apparently peculiar to Western Australia. In other countries lupins have long been used to build up inferior soils, and as a green manure in orchards, but otherwise are generally referred to as a source of dangerous glucosides rather than nutritious seeds. However, in Western Australia, lupins have proved themselves of great value, not only to reclaim poor quality wind-eroded country, but also to provide a much needed protein-rich supplement during the dry summer months. The variety grown, *Lupinus varius*, is a robust blue-flowered plant. Except in the seedling stage, it is rarely eaten by stock when green, being left unharned to produce a prolific crop of seeds. It is the seed and dried plant material which constitute the supplement so relished by sheep as the summer progresses.

In Appendix II. the compositions of 15 samples of lupin are recorded. While not as constant in composition as field peas, the variation seen is not great considering the varied origin. The Subiaco samples, for example, were obtained from good stands of lupins growing on virgin coastal sand; despite complete lack of fertiliser or cultivation, the poorest sample contained 30% crude protein and 0·39% P. It seems that the roots of the lupin plant are very good at foraging, so that maximum use can be made of such food constituents as are in the soil.

As can be seen from the summary in Table I., the West Australia Blue Lupin is very rich in crude protein, averaging 34% which is half as much again as is present in field peas. This high protein content no doubt contributes largely to the high nutritive value of the seeds, as during the long summer lack of protein is the most serious deficiency seen in West Australian pastures. It should be emphasised that these lupins contain more crude protein than commercial linseed meal.

Lupin seeds are also a useful source of mineral matter, containing as much phosphorus as field peas and twice as much calcium. It is indeed surprising that lupins growing on phosphate deficient soils can concentrate so much of this vital element in their seeds. As a point of scientific interest it may be noted that lupin seeds contain a much lower proportion of phytin phosphorus than do most other seeds and grains (Snook, 1938).

NEW ZEALAND BLUE LUPIN (*L. augustifolius*).

The New Zealand Blue Lupin is now extensively grown as a green manure crop in orchards and vineyards. It is possible that this strain could be grown as a source of lupin seeds for sheep in districts where the common blue lupin does not thrive. As can be seen from Table I., the seed of the New Zealand variety appears to be somewhat richer in crude protein than the local strain and contains definitely less crude fibre. It does not follow, however, that the New Zealand strain is to be preferred. In the first place it has to be proved that the seeds of imported varieties are palatable. A food is useless, no matter how nutritious it may be, if stock refuse to eat it. It is common knowledge that many varieties of lupins grown overseas contain bitter alkaloids which make them distasteful to stock and poisonous if eaten. Careful trials will therefore be necessary before any new variety of lupin can be accepted as a source of food for stock.

In an effort to obtain information concerning the presence of undesirable alkaloids (bitter substances, mostly poisonous) in lupin seeds, a number of analyses were carried out by the Government Chemical Laboratories for the Department of Agriculture. A summary of the results is given in Table II.

TABLE II.
ALKALOIDS PRESENT IN LUPIN SEEDS.

	Percentage lupanin in seeds grown at—	
	Wongan Hills.	Merredin.
<i>Lupinus termis</i>	2.6	2.7
N.Z. Blue lupins	1.1	1.4
	1.4	1.4
W.A. Blue lupins	0.4	0.6
	(5 samples)	
"Sweet" Yellow Lupin	0.2	...

If the percentage of lupanin does give a reliable index of the presence of dangerous substances then the above figures indicate that the New Zealand variety may not be altogether successful as a source of sheep feed.

YELLOW LUPIN (*Lupinus luteus*).

Although it is realised that the seeds of bitter yellow lupins have no value as a foodstuff without treatment, it is interesting to study the composition as set out in Appendix IV. and summarised in Table I. It will be seen that, on the information at present available, these seeds contain more crude protein than any other seed grown in this State. But despite the apparent high food value, the seeds are useless and illustrate all-too-well that the first necessity required of a food is that it should be palatable and free from poison. The seeds of the common yellow lupin are very bitter because of the presence of poisonous alkaloids. Plant breeders, however, are studying "sweet" strains of this legume and these may prove very valuable as stock food.

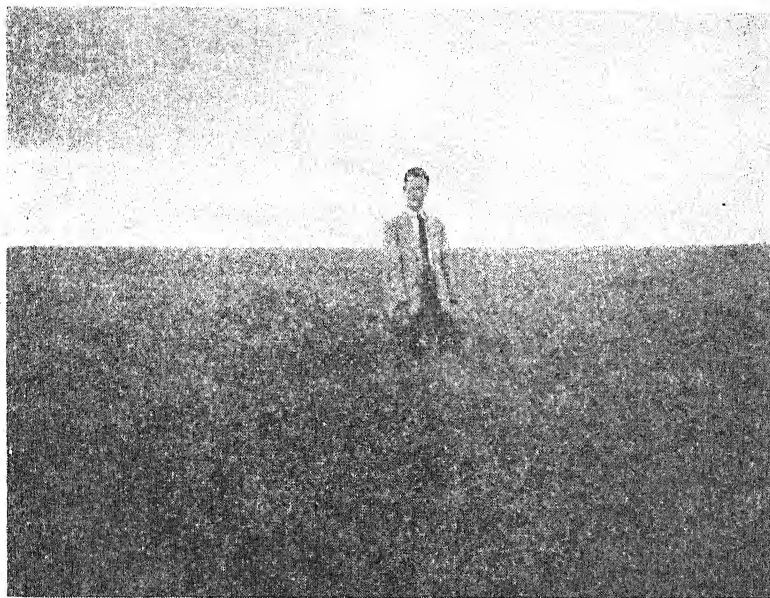
As a point of interest it should be noted that "sweet" yellow lupins grown in W.A. from seed imported from Germany had a composition almost identical with the original seed except that the German seed contained double the amount of phosphorous. This is the first example seen where a leguminous seed shows the same trend characteristic of cereals. It has been shown (Snook, 1939) that cereal grain grown in W.A. contains only about half the phosphorous usually found in British cereals.

TANGIER PEA (*Lathyrus tingitanus*).

In this State, farmers have grown Tangier Peas successfully for many years. In spring, this legume makes phenomenal growth, producing heavy yields of palatable nutritious greenstuff. In the Avon valley, for example, Tangier Pea plants will keep green until mid December, providing succulent feed long after most other herbage is dry. Under favoured conditions, seed production is heavy, a sample threshing of the dry plant material harvested at Muresk in 1946 yielding seed at the rate of 28 bushels per acre. When stock are admitted all the Tangier Pea plant is eaten—leaves, seeds and stems.

As can be seen from Appendix V., the Tangier Pea seed is very rich in crude protein, containing about 40 per cent., which is almost double the amount present in field peas and one-third more than is present in linseed meal. Such seeds are obviously a very valuable protein-rich concentrate and it is indeed a pity that practical difficulties in harvesting the seed have so far prevented the sale of Tangier Peas for feeding to livestock. In fact, it is the high price of the seed which has, to date, limited the more extensive planting of Tangier peas for green feed. Dairy-men in Queensland were most enthusiastic about Tangier Peas as a source of greenstuff for milch cattle but seem to have ceased making enquiries for seed in Western Australia as regular supplies could not be obtained, although £3 per bushel was offered. In view of the heavy yields of seed grown locally in small plots, it does seem strange that more farmers have not found it profitable to grow Tangier Peas

for sale as seed, or that farmers growing the crop for grazing have not been able to conserve sufficient seed for their own use. The green plants are very palatable and will be eaten out if accessible to stock. It seems that the closing up of a small area is all that is required to provide the farmer with continued stocks of seed.

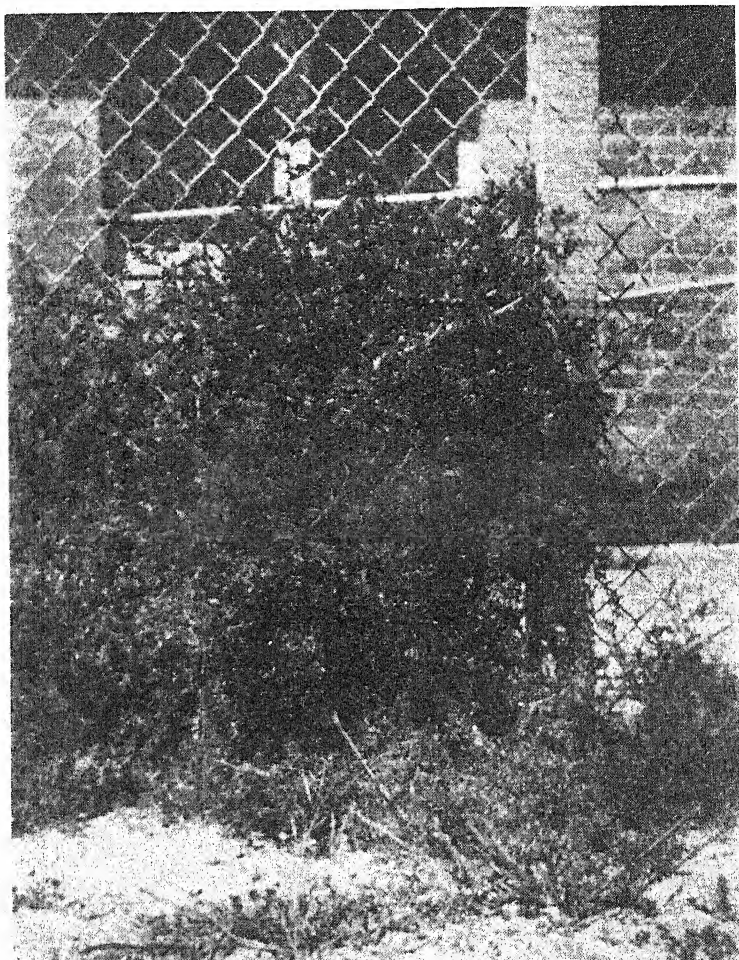


Bulk Crop of a Selected Strain of Common Vetch.

Grown on sandy soil, Wongan Hills Research Station. Planted on 28th May, at rate of 35 lbs. seed and 112 lbs. superphosphate per acre. Photo taken on 20th October, 1947.

VETCHES (*Vicia* spp.).

Vetches have been insignificant members of West Australian pastures since farming was commenced, but had not attracted serious attention until Mr. E. Bailey, Plant Introduction Officer, C.S.I.R., noted that a strain of the Common Vetch (*V. sativa*), which had been growing at Muresk for many years appeared to be definitely superior to the field pea as a source of fodder and seed. This vetch has the particular advantage of flowering early, so that a good crop of seed is assured under wheat belt conditions. Other strains of vetch have since been introduced by Mr. Bailey, and it seems certain that some or all of these will become important forage crops. The Department of Agriculture procured seeds of a vetch which had proved promising at Hawkesbury College, N.S.W. This also is a selected "strain" of the Common Vetch; it has the advantage of early maturity and an erect habit of growth which should facilitate harvesting by machinery. In the above illustration is shown part of the five acres being grown this year at Wongan Hills Research Station. The cultivation of this crop is discussed in a separate article in this Journal. Seeds of this vetch were also planted on 22nd June, in poor quality virgin sand at the Animal Health Laboratory at Nedlands. Despite this late sowing, the small plot grew well with no other attention than the application of a little superphosphate. It seems that this strain of vetch will prove particularly useful on light land and in low rainfall areas. It is quick maturing and may prove a useful cover crop in wind-swept or eroded areas. No tests have been carried out to determine recovery after grazing, but stock are very fond of the green plant which therefore needs protection during the latter part of the season, if seed is desired.



Palestinian Vetch.

Planted on virgin sandy soil at Nedlands on 1st April, these two plants were cut to ground level in June and July. Photo taken on 6th October, 1947.

In small plot trials at Muresk in 1946, another variety, the Palestinian Vetch (*V. dasycarpa*), proved outstanding, yielding seed at the rate of 64 bushels (3,900 lbs.) per acre and dried roughage at the rate of nine tons per acre. It should be stressed that these yields were obtained from small plots where plants usually do much better than under field conditions but even so, the yields are most impressive. A few seeds of this Palestinian vetch were planted on poor, sandy soil at the Animal Health Laboratory in April, 1947, and grew profusely although surrounding weeds were heavily infested with Red Mite. The plants shown in Illustration II., were twice cut to ground level but recovered well and promise to give a heavy yield of seed. It was noticed that Palestinian vetches at Wongan Hills were flowering in mid October, by which time the Hawkesbury strain of the common vetch had completed setting seed. This indicates that the Palestinian vetch may be too late a variety

to set seed satisfactorily under wheat belt conditions. Experiments over a period of years will be needed to determine this point. At present, however, it can be stated that the Palestinian vetch produces an abundance of very palatable green feed and under suitable conditions will give heavy yields of seeds. On present indications it seems that selected strains of the common vetch will prove most useful in the drier wheat belt areas, while the Palestinian vetch will provide both green-feed and seed in districts with more prolonged growing periods.

Vetches possess many advantages—they are hardy, resistant to red mite and black stem rot, and the seeds are not affected by the pea weevil. The green plant is greatly relished by stock and from the limited experience now available it seems that this crop will respond well after grazing. Naturally the yield of seed would be expected to fall if the crop is grazed but vetches possess the definite advantages over field peas in that they can be sown early, grazed, and then be shut up to set seed.

Are Vetch Seeds Poisonous?—Occasional references can be found in Veterinary literature to the deaths of livestock following consumption of vetch seed. Interestingly enough, most of these references are old, they come from abroad, and no case of sheep poisoning has been cited. Vetch seeds contain cyanogenic glucosides from which prussic acid can be liberated; this may produce cyanide poisoning. Obviously, it is important to determine if the strains of vetch showing promise in this State are in any way dangerous.

The seed is the source of danger and it seems that large amounts have to be eaten in a short space of time if toxic results are to follow. Only limited amounts of seed have so far been available, hence it has not been possible to carry out feeding tests on large animals. It is planned to do this after the current harvest. Meantime, experiments have been carried out using mice and guinea pigs. Chemical determinations have been made also.

Young mice were starved and then given as much crushed vetch seed as they would eat. No other food was supplied but the animals continued to grow on this restricted diet. No harmful effect was observed after 14 days feeding.

Guinea pigs would not readily eat the vetch seeds but these animals were very fond of the fully grown seeds in half-ripe pods. Guinea pigs showed no symptoms after consuming this ration for two days. This test is of considerable practical interest as if livestock gain access to a field of vetches just as the pods are ripening, they could consume large quantities of seed. Even under these conditions, it does not seem that the crop will be dangerous.

Qualitative chemical tests revealed that the strains of the common vetch selected by Bailey and Millington, both contained substances producing prussic acid. In contrast, the Palestinian Vetch and another importation (*V. monantha*) seemed quite free of dangerous compounds. This suggests that the plant breeder may be able to select toxin-free strains.

Samples of the common vetch were submitted to the Government Chemical Laboratory so that the amounts of prussic acid liberated could be determined. These were found to contain up to 0.03 per cent. HCN. in the dry matter.

It is disconcerting to know that some vetch seeds do contain significant amounts of cyanogenic glucosides, as it is always possible that under certain climatic and soil conditions, more dangerous amounts may be produced. Fortunately, tests so far made do not indicate that vetch seeds will be dangerous in practice. Franklin and Reid (1944) found that commercial linseed meals and linseed nuts contained

from 0.05 to 0.06 per cent. HCN. in the dry matter. This is double the maximum amount so far found in West Australian vetch seed. It was only by force-feeding large amounts of linseed meal to starving sheep that deaths could be produced.

Cyanide poisoning most commonly occurs when hungry stock engorge themselves with a potentially dangerous food. Such engorgement will rarely be possible with vetch seed and even if it does occur, the analytical data at present available imply that the risk will be slight. As soon as sufficient seed is available feeding tests will be carried out at this Laboratory, using large animals and poultry. Such tests are necessary in view of the hope that it may be found possible to harvest vetch seed cheaply for use as a protein-rich concentrate for dairy cows and poultry. As can be seen from Table I., vetch seeds should be of high food value to growing and lactating animals.

CHICKLING VETCH (*Lathyrus sativus*).

This so-called vetch is of the same family as the Tangier Pea. In Northern Africa and India the seeds have for centuries been used as stock food and to supplement the diets of poor people. Mr. Bailey has made available samples of seed from Chickling Vetches grown at Muresk.

In the tests so far conducted in Western Australia the Chickling vetch has proved disappointing as a source of green material but the yields of seed have been impressive. Small plots at Muresk in 1946, yielded seed at the rate of 50 bushels (3,250 lbs.) per acre compared with 64 bushels from the Palestinian vetch and 45 bushels from the Muresk vetch. The seed has much the same composition as vetch seed but caution will need to be observed in feeding this product to stock. There are many references in the literature (see Hurst, 1942) to chronic poisoning ("lathyrism") following the continued consumption of seeds of the Chickling vetch and although tests made at this Laboratory indicate that locally grown seeds are harmless when fed to mice, there seems little point in introducing this suspect legume unless it possesses some very definite advantage. In this regard it may be recorded that Chickling vetches sown in April, 1947, at the Animal Health Laboratory did not thrive and dried up during the dry weeks of August. Tangier Peas planted nearby have grown well and are still growing at time of going to Press. For the present, farmers are not advised to grow Chickling vetch.

LATHYRUS OCHRIS.

This is another relative of the Tangier Pea which has been imported for trial. It shows some promise as a producer of seed in the Avon Valley but further trials will be needed to determine its value.

Plants of this species grown at the Animal Health Laboratory, Nedlands, did not thrive. As far as can be judged from Table I., the seeds are somewhat inferior to vetches in feeding value.

DIGESTIBILITY OF LEGUMINOUS SEEDS.

In assessing the value of a foodstuff, it is important to know just how digestible are its various components. This is particularly important where roughages are concerned; hay, for example, can vary enormously in value according to stage of growth at time of cutting. Fortunately, the nutrients present in seeds and grains are in most cases readily digested and the ease of digestion is much the same wherever the seeds may be grown. Table III. has been prepared to show the digestibility of the material in leguminous seeds when fed to ruminants. It will be noticed that workers in Germany and the U.S.A. arrived at very similar figures for the two legumes quoted and it seems fairly safe to assume that locally grown leguminous seeds will have much the same digestibility.

TABLE III.

DIGESTION CO-EFFICIENTS FOR LEGUMINOUS SEEDS FED TO RUMINANTS.

	Crude Protein.	Carbo-hydrate.	Fat.	Fibre.
<i>Peas—</i>				
Germany (Kellner, 1926)—Range in four investigations	83-90	93-94	55-75	26-66
U.S.A. (Henry & Morrison, 1928)—Average of two investigations	83	94	55	26
Figures used for local field peas	85	94	60	50
<i>Soya Bean—</i>				
Germany (four investigations)	87-91	62-76	89-94	71
U.S.A. (seven investigations)	91	81	92	75
<i>Vetch Seed—</i>				
Germany (two investigations)	88	100	92	90
<i>Lupin Seed—</i>				
Germany (twelve investigations)	85-96	75-100	71-96	77-100

Protein Quality in Leguminous Seeds.

It is now generally realized that proteins in different foods do not have the same value when fed to livestock. This is because some proteins are lacking in one or more of the essential amino-acids. Zein, the major protein in maize grain, is the classical example of a poor-quality protein, as it is lacking in tryptophane and lysin, both of which are essential amino-acids. It follows that attention must always be paid to the "quality" or "biological value" of the protein when estimating the value of a foodstuff.

Attention is drawn to this subject because various workers, Lugg *et al.* (1944, 1945) in particular, have stressed the fact that the proteins in certain leguminous seeds are comparatively deficient in the sulphur containing amino-acids, particularly methionine. The inference has been drawn that leguminous seeds may not be such useful foods as had been generally accepted.

It should be remembered, however, that most single foodstuffs have one or more deficiencies, and the art of feeding is to blend ingredients so that the deficiencies are cancelled out. For example, cereal grains are deficient in lysin, a very important amino-acid, whereas leguminous seeds are rich in this essential. It follows that a supplement of leguminous seeds will improve a cereal ration for this reason. In a similar manner the shortcomings of leguminous seeds may be corrected by other foodstuffs in the diet.

In practice, leguminous seeds have proved of great value as stockfood in Western Australia. Farmers have found that sheep, in particular, produce excellent mutton and wool wherever peas or lupin seed form part of the diet. Not only do the stock thrive, but the fertility of the land always increases when legumes are established. It follows that if productive strains of vetches can be selected, or simpler methods of handling the Tangier Pea can be evolved, the farmer and the State will both benefit. Field peas were a great disappointment to many farmers this season, but there is real reason to hope that much more dependable, and even more nutritious, legumes may soon be available for use in the wheat belt.

SUMMARY.

Analytical data are presented showing the composition of various leguminous seeds grown in Western Australia.

Seeds of the same species grown in different years and in different parts of the State, were remarkably uniform in composition. The average values are tabulated.

Tangier Peas (*Lathyrus tingitanus*) were found to contain more crude protein than any other edible seed investigated, the six samples averaging 40 per cent. in the dry matter.

The possible value of selected strains of vetches (*Vicia spp.*) as a source of greenfeed and protein-rich seed, is discussed.

Seeds of the Common Vetch (*Vicia sativa*) contain cyanogenic glucosides but chemical and feeding tests do not indicate that the seeds will be dangerous. There is no suspicion that any part of the vetch plant other than the seed, is likely to be poisonous.

Some consideration is given to the nutritive value of the protein in leguminous seeds.

It is suggested that more dependable legumes than field peas (*P. arvense*) may be grown for stock food in Western Australia.

ACKNOWLEDGMENTS.

Mr. E. Bailey, Plant Introduction Officer, C.S.I.R., first drew the author's attention to the potential value of vetches as a source of fodder and seed. Thanks are also due to Mr. Bailey for samples of seed used in chemical and feeding tests.

Certain of the legume samples were obtained from the various State Research Stations. I wish to thank Mr. I. Thomas, Superintendent of Wheat Farms, for arranging for me to receive these samples.

A proportion of the analytical work recorded in this paper was carried out for the Department of Agriculture by the Government Chemical Laboratories, and appreciation is expressed for this help and co-operation.

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APPENDIX I.

COMPOSITION OF SEEDS.

FIELD PEAS "WHITE BRUNSWICK" (*Pisum arvense*).

Percentage Composition—Dry Matter basis.

Source of Sample.	Crude Protein (N x 6.25).	Fat (Ether Extract).	Crude Fibre.	Carbo- hydrate (N-free Extract).	Ash.	Cal- cium (Ca).	Phos- phorus (P).
Merredin (1932)	26.5	...	...	...	3.65	0.08	0.36
York (1926)	22.3	1.5	5.5	67.8	2.84	0.07	0.38
York (1933)	22.5	...	...	...	3.18	0.08	0.34
Burekup (1932)	22.6	...	...	...	3.34	0.08	0.41
Burekup (1933)	22.5	...	...	...	3.66	0.06	0.61
Burekup (1935)	22.7	...	...	...	3.52	0.07	0.47
Wonnerup (1933)	25.8	...	...	...	3.30	0.06	0.37
Kulja (1945)	22.9	1.8	6.0	66.6	2.74	0.07	0.23
Average 8 samples ...	23.5	1.6	5.8	65.8	3.3	0.07	0.40
<i>Overseas analyses for Comparison.</i>							
British (Marshall and Hal- nan, 1932)	26.2	1.8	6.3	62.4	3.3	0.10	0.46
U.S.A. (Yearbook, U.S.A., 1939)	25.7	1.3	6.5	62.9	3.6	0.09	0.44

APPENDIX II.

COMPOSITION OF SEEDS.

WEST AUSTRALIAN BLUE LUPINS (*Lupinus varius*).

Percentage Composition—Dry Matter basis.

Source of Sample.	Crude Protein (N x 6.25).	Fat (Ether Extract).	Crude Fibre.	Carbo- hydrate (N-free Extract).	Ash.	Cal- cium (Ca).	Phos- phorus (P).
Merredin (1932)	36.0	...	...	...	3.00	0.19	0.41
Wongan Hills (1932)	34.4	...	...	...	3.67	0.15	0.34
Wongan Hills (1933)	36.3	...	...	...	3.85	0.16	0.44
Wongan Hills (1935)	32.7	...	...	...	2.63	0.16	0.26
Wongan Hills (1939)	34.1	2.6	19.3	43.0	3.00	0.13	0.32
Wongan Hills (1940)	32.5	2.3	18.8	43.4	3.00	0.13	0.32
Subiaco (1933)	36.9	...	...	...	2.44	0.24	0.36
Subiaco (1935)	33.2	...	...	...	2.71	0.19	0.34
Subiaco (1936)	30.0	...	...	...	2.63	0.23	0.39
Burekup (1932)	30.9	...	...	...	3.46	0.14	0.34
Burekup (1933)	33.3	...	...	...	4.02	0.18	0.61
Chapman (1932)	38.8	...	...	...	3.64	0.16	0.41
Forest Grove (1939)	35.4	2.3	22.0	37.4	2.9	0.10	0.30
Commercial (1939)	31.7	2.7	18.9	43.3	3.4	0.14	0.54
Agric. Dept. (1940)	32.5	2.5	18.6	43.3	3.1	0.15	0.41
Average 15 samples ...	34.0	2.5	19.5	40.8	3.2	0.16	0.39

APPENDIX III.
COMPOSITION OF SEEDS.
NEW ZEALAND BLUE LUPINS (*L. angustifolius*).

Percentage Composition—Dry Matter basis.

Source of Sample.	Crude Protein (N x 6.25).	Fat (Ether Extract).	Crude Fibre.	Carbo- hydrate (N-free Extract).	Ash.	Cal- cium (Ca).	Phos- phorus (P).
Upper Swan (1939) ...	38.0	3.3	14.0	41.9	2.8	0.19	0.31
Guildford (1939) ...	33.8	4.3	14.0	45.2	2.7	0.16	0.24
Merredin (1940) ...	37.0	3.3	13.3	43.8	2.6	0.21	0.27
Wongan Hills (1940) ...	36.5	3.6	13.3	43.9	2.7	0.19	0.25
Average 4 samples ...	36.3	3.6	13.6	43.8	2.7	0.19	0.27

APPENDIX IV.
COMPOSITION OF SEEDS.
YELLOW LUPINS (*L. luteus*).
Percentage Composition—Dry Matter basis.

Source of Sample.	Crude Protein (N x 6.25).	Fat (Ether Extract).	Crude Fibre.	Carbo- hydrate (N-free Extract).	Ash.	Cal- cium (Ca).	Phos- phorus (P).
Crawley (1939) * ...	45.0	3.7	16.5	31.1	3.7	0.20	0.45
Merredin (1940) ...	43.0	4.6	16.2	32.4	3.8	0.28	0.41
Wongan Hills (1940) ...	42.2	4.7	16.1	33.1	3.9	0.26	0.41
Dept. Agric. (1940) ...	41.4	4.3	16.0	34.4	3.9	0.30	0.41
Dept. Agric. (1940) ...	41.5	4.4	16.4	33.6	4.1	0.30	0.42
Average 5 samples ...	42.6	4.4	16.2	32.9	3.9	0.27	0.42
For Comparison. * Seed obtained from Ger- many (1939) ...	41.8	4.0	16.5	32.7	5.0	0.26	0.85

* "Sweet" variety.

APPENDIX V.
COMPOSITION OF SEEDS.
TANGIER PEAS (*Lathyrus tingitanus*).
Percentage Composition—Dry Matter basis.

Source of Sample.	Crude Protein (N x 6.25).	Fat (Ether Extract).	Crude Fibre.	Carbo- hydrate (N-free Extract).	Ash.	Cal- cium (Ca).	Phos- phorus (P).
Dwarda (1933) ...	40.3	...	...	...	4.6	0.12	0.33
Dwarda (1934) ...	40.7	...	...	...	...	...	0.33
Dwarda (1935) ...	41.2	...	...	...	...	...	0.35
Dwarda (1945) ...	41.4	1.1	5.2	46.5	5.8	0.13	0.33
Wonnerup (1933) ...	39.0	...	...	...	3.5	0.14	0.69
Wonnerup (1935) ...	39.7	...	...	...	...	...	0.33
Average 6 samples ...	40.4	1.1	5.2	48.7	4.6	0.13	0.33

HERD RECORDING RESULTS AS A COMPARISON with Factory Returns —

R. A. PAUL, Assistant Superintendent of Dairying.

FREQUENTLY, members of the Grade Herd Recording Scheme attempt to compare and reconcile the butter-fat yields of their cows as given by the Herd Recorder, and the returns as received from the butter factory.

So numerous have been inquiries regarding this matter over the past few months, it was considered that an endeavour be made to show the farmers the futility of the comparison. The purpose of this article is to do just that to the satisfaction of both farmers and factory manager.

To enable a full appreciation of the facts, it is proposed to deal with the question from the following angles:—

1. The Daily Yield.
2. The Monthly Yield.
3. The Yearly Yield.

THE DAILY YIELD.

On this basis there should be and there is a very close agreement between the factory return and the Herd Recorder's results. Numbers of members who have been asked this question agree that the results are very close, sometimes the recorder's results are higher and at other times lower, but at all times the agreement is good.

This is to be expected where the whole of the two milkings at which the recorder has taken his samples are separated, kept apart from other cream and forwarded to the factory.

Even allowing for milk used for house and calf rearing and loss through the separator, results have been found to vary little.

THE MONTHLY YIELD.

Unfortunately this is the basis on which the majority make their comparison. It is unfortunate for the reason that it offers the greatest scope for variations, and it is the unit on which the herd recording results are measured.

Those who have had some experience of recording know that the herd is tested at approximately 30-day intervals, and the daily yield both of milk and butter-fat is multiplied by 30 to give the yield for the sub-period.

It is in discussing the factors which can affect the yield of a cow from day to day within this 30-day period, that it is hoped to point out the futility of a comparison between two entirely dissimilar services as given by the recorder and the factory.

In the first place it is desired to stress that the only accurate method of assessing a cow's production is to sample and test at each milking during the lactation period, if that were done a very close relationship would be found between the two results. However, that, of course, is not economically possible, but it has been found in practice that the average production of a cow for her whole lactation, as calculated in 30-day sub-periods is sufficiently accurate for comparative purposes. It is known, however, that the test for any one sub-period of 30 days may differ considerably from a true result obtained by carrying out the test each day.

The causes of such variations in the daily test are recognised by farmers, but perhaps it is not realised just how frequently these variations may occur or to what extent they can and do affect each individual test.

Daily variations may be due to one or more of the following causes:—

(a) *Weather Conditions*.—These do not continue uniformly throughout the month; extremes of heat, cold wind and rain affect both the quantity of milk and the percentage of fat in the milk.

(b) The pasture and feed conditions will almost certainly vary throughout the monthly period; this will give day to day changes in production which are multiplied by 30 for the sub-period.

(c) Cows that are tested just after calving, when in season, sick or otherwise upset are irregular in their yields for a period afterwards.

(d) Extra rations may be handed out just prior to and at testing time, so having the effect of raising production during the 24-hour testing period, and then taken away after the recorder's visit for the remainder of the sub-period.

(e) Palatability and quantity of water available may vary at and after the monthly visit of the recorder.

(f) It is possible that on recording days the herd is milked out with a little more care than is usually given.

As an illustration of the actual day to day variation which may occur in a herd of cows, the following record of a herd of 13 cows which was tested daily during one month at Vermont Experiment Station is given as an example:—

Date.	Milk. (lbs.)	(30-day sub-period.)	
		Fat. (lbs.)	Fat. (lbs.)
1.	171	6.48	194.4
2.	182	7.64	229.2
3.	182	6.61	198.3
4.	187	7.42	222.6
5.	204	8.49	254.7
6.	220	9.39	281.7
7.	216	9.53	285.9
8.	228	9.92	297.6
9.	240	10.18	305.4
10.	237	10.62	318.6
11.	250	10.68	320.4
12.	246	9.84	295.2
13.	226	9.85	295.5
14.	248	10.94	328.2
15.	255	10.63	318.9
16.	243	10.04	301.2
17.	241	10.39	311.7
18.	248	10.86	325.8
19.	245	10.05	301.5
20.	264	10.33	309.9
21.	243	9.11	273.3
22.	241	10.34	310.2
23.	250	10.78	323.4
24.	262	10.74	322.2
25.	262	10.24	307.2
26.	272	10.99	329.7
27.	260	10.09	302.7
28.	255	11.78	353.4
29.	256	11.75	352.5
30.	262	11.50	345.0
Total 7,096		297.21	

It will be seen from the above table that on 20 days the fat as calculated for the 30-day sub-period is in excess of that actually produced daily for the 30 days, whilst on the other ten days it is below. The variation is considerable being from 103 lbs. below the actual yield to as much as 56 lbs. above, or an overall variation of 159 lbs. between the highest and lowest productions for the month estimated on the 30-day sub-period.

Variations such as the above are not uncommon under our own conditions, particularly in the early spring months, when the flush of pasture growth commences and again in the early summer months, when the feed rapidly dries off.

It is as well to bear in mind that provision is made in the rules to cover this as a 25 per cent. variation is allowed between two successive tests before the recorder is justified in believing the results abnormal.

From the foregoing it will be seen that it is neither possible nor desirable to compare the *estimated* monthly herd recorded production with the *actual* monthly factory return.

THE YEARLY YIELD.

As might be expected the causes of variations as discussed under the previous section do to a degree average themselves out over a full year's production, with the result that in practice it has been found the yearly production of a herd, as given by the Herd Recorder, will agree to within 5 per cent. to 7 per cent. of the return from the factory. Under farm conditions this is considered to be a sufficiently accurate guide as a means of comparing one cow with another.

Farmers have been heard to complain that on the basis of the yearly yield, they cannot reconcile the two results within several hundred pounds. Taking a 25-cow farm with an average of 200 lbs. per cow as estimated by the recorder, it will be seen that the yearly total fat produced on the farm equals 5,000 lbs. Supposing a 5 per cent. variation occurs, it would represent a total of 250 lbs. of fat over the whole production.

In concluding, it is desired to point out that herd recording serves a very useful purpose in aiding to increase herd production and yield of milk and butter-fat per acre. The system should be availed of to cut those losses brought about through under-feeding of high producing stock and the keeping of low producing stock to breed from and milk. Herd recording should not be carried on as a means of policing factory operations since for this purpose it is of little or no value.

SEED CERTIFICATION

Phalaris Tuberosa.

The certification of subterranean clover seed by the Department of Agriculture was commenced in 1934. In that year only the Dwalganup early strain was under consideration, but the scheme now includes Mt. Barker (midseason), Tallarook, Bacchus Marsh, and Yarloop (white seeded).

Following a request from Messrs. M. C. Fry and Sons, Donnybrook, certification will be further extended during the coming season to include *Phalaris tuberosa*. The main guarantee will be freedom from the annual *Phalaris minor*, but the certificate will also cover purity and germination. It is very pleasing to note the increased interest in the local production of agricultural seeds and there is no reason why the keen demand for such seeds as Wimmera rye grass, *Phalaris tuberosa* and lucerne should not be met from within the State.

DESTROY THAT FRUIT AND HELP CONTROL FRUIT FLY.

A SIMPLE INCINERATOR FOR ORCHARD OR GENERAL USE.

By W. C. HOLLAND, Fruit Fly Inspector.

Owing to the ravages of Fruit Fly during the past few seasons, with the heavy losses resulting to growers individually and collectively, it will amply repay orchardists to give serious thought to the control measures employed with a view to the prevention of such losses in years to come.

With this pest, the old saying that "prevention is better than cure," certainly applies and prevention of further infestation would be obtained if all fruit which had been "struck" were effectively disposed of before the larvae emerged. All growers are therefore, advised to keep this point firmly in mind and make every endeavour to carry it out to the best of their ability during the harvesting season.

The procedure of careful destruction of waste and infested fruit, together with rigid orchard sanitation and regular application of the proper foliage baits recommended by the Department, will adequately control Fruit Fly, and make this present major pest become a relatively minor one in all our fruit growing districts.

During the harvesting season, and indeed throughout the year, the following precautions should be carried out by all pickers :—

1. Harvest all fruit as soon as it reaches a state of sufficient maturity, whether marketable or not.
2. Have a separate water-tight container for any fruit showing signs of fly. Do not drop this fruit on the ground.
3. Gather all windfalls regularly and destroy waste fruit immediately.

To try and assist growers in the fight against Fruit Fly, tests have been carried out with a home-constructed incinerator with very good results. The incinerator consists of a 44 gallon drum with the top removed ; the bottom and 2 feet of the sides are perforated with draught holes about one inch in diameter and five or six inches apart (see accompanying sketch).

Four short legs could be attached to the drum to raise it from the ground, or it may be stood on bars or even four bricks to provide adequate draught.

For convenience of handling and transport, a pair of handles or lengths of water piping welded to the side of the drum, prove most useful.

To operate the incinerator, stand two or three fairly long thick pieces of wood on end in the drum to form a vent and build a good fire in the bottom. When well alight, commence to add fruit until the drum is full, then place another drum with both ends removed on top to increase the draught and add more fruit if necessary. If only a small quantity of fruit is to be destroyed, one drum only is suitable, but the addition of the second one greatly improves the performance.

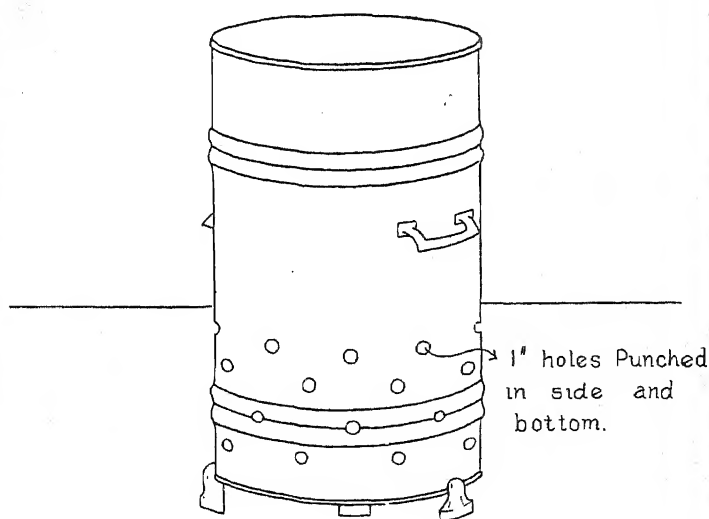
One grower recently destroyed 70 boxes of apples during a day by this means, and is so impressed that he is putting in a more permanent unit.

A surprisingly small amount of wood is consumed by this arrangement, and little or no attention is required once the fire is burning well, except the addition of further quantities of fruit from time to time. If large quantities of fruit are being destroyed, add more wood as required.

In conclusion, I wish strongly to recommend all growers to adopt the method described, as the cleanest, handiest and best way of disposing of infested and unwanted fruit, as well as other household and farm rubbish, which from a health standpoint, it is desirable to destroy by burning.

ORCHARD INCINERATOR

(Made from 44 Gallon drum.)



PURE BRED HERD RECORDING 1946-47

By M. CULLITY, Superintendent of Dairying, and B. H. DRAKES, Assistant,
Dairy Records.

During the year, 517 cows from 35 herds completed test, compared with 424 cows from 34 herds the previous year.

This is an increase of 21.9% in the number of cows and is the highest number tested in any year since the inception of the Official Australian Pure-bred Dairy Cattle Production Recording Scheme in this State.

Of the above number, 57 cows were withdrawn for various reasons before completing 150 days under test, and their productions are not included in any of the averages.

The remaining 460 averaged 6,545 lbs. of milk, average test 4.56% and 298.53 lbs. butter-fat. This is an increase of 18.6 lbs. of butter-fat over last year's figures.

The average production of all cows completing test since 1934 is shown in Table 1.

TABLE 1.
AVERAGE PRODUCTION—PURE-BRED HERDS.

Year.	No. of Cows Completing Test.	Average Butter-Fat per Cow.
		lb.
1934-35	305	320.26
1935-36	367	297.17
1936-37	319	300.87
1937-38	333	298.08
1938-39	375	292.40
1939-40	382	305.88
1940-41	372	298.38
1941-42	290	322.84
1942-43	294	321.27
1943-44	289	311.57
1944-45	344	289.42
1945-46	393	279.93
1946-47	460	298.53

The percentage of cows passing standard is shown in Table 2, from which it will be seen that over all breeds an increase of 8.3% took place, whilst the Jerseys showed a slight improvement, the Guernseys 9.3% and the Australian Illawarra Shorthorns 13% better than last year.

In view of the fact that only 52.1% of all cows tested reached standard production, there is still ample room for improvement.

TABLE 2.
PERCENTAGE OF COWS PASSING STANDARD.

Year.	Australian Illawarra Shorthorn.	Guernsey.	Jersey.	Total.
1937-38	59.1	68.7	35.6	52.1
1938-39	53.8	71.4	55.2	57.9
1939-40	48.0	77.5	64.2	59.2
1940-41	52.0	61.0	51.0	54.0
1941-42	73.0	68.3	59.7	68.3
1942-43	67.6	67.9	55.0	64.3
1943-44	57.8	52.1	73.3	61.9
1944-45	52.5	43.4	72.2	57.8
1945-46	43.1	33.3	52.9	43.8
1946-47	56.1	42.6	53.6	52.1

The number of cows passing standard and the proportion in each age group for each breed is given in Table 3.

This table shows that the Junior 2-year-olds again put up a creditable performance, approximately 78% of them exceeding standard. The Mature and Junior 4-year-olds were disappointing.

TABLE 3.
COWS PASSING STANDARD.

Age Class.	A.I.S.		Guernsey.		Jersey.		All Breeds.	
	No. of Cows Tested.	No. Passing Stan- dard.	No. of Cows Tested.	No. Passing Stan- dard.	No. of Cows Tested.	No. Passing Stan- dard.	No. of Cows Tested.	No. Passing Stan- dard.
Mature	54	20	44	8	41	11	139	39
Senior 4 years	15	6	4	3	10	8	29	17
Junior 4 years	18	5	8	7	11	5	37	10
Senior 3 years	20	10	9	9	11	7	40	24
Junior 3 years	28	20	15	7	11	7	54	36
Senior 2 years	29	15	12	7	11	7	52	29
Junior 2 years	62	51	16	12	31	22	109	85
Total	226	127	108	46	126	67	460	240
Percentage		56.1		42.6		53.6		52.1

Table 4 has been compiled this year to include the average milk production and percentage test as well as average butter-fat production. It will be seen that for all breeds, the only age groups which failed to reach standard were the Mature and Junior 4-year-olds.

In the Senior 4-year-old class the Jerseys did exceptionally well, ten averaging 7,741 lbs. milk with an average test of 5.44%, equal to 421.34 lbs. butter-fat.

In the Senior 3-year-old class, nine Guernseys averaged 7,096 lbs. of milk with an average test of 5.18%, equal to 368.12 lb. butter-fat.

The 62 Junior 2-year-olds, Australian Illawarra Shorthorn breed, averaged 6,770 lbs. milk, average test 4.13% with 280.10 lbs. butter-fat, compared with an average of 259.76 lbs. of butter-fat the previous year.

TABLE 4.
AVERAGE PRODUCTION IN EACH AGE CLASS—1946-47.

AGE CLASS.	A. I. S.				GUERNSEY				JERSEY				ALL BREEDS.			
	B/Fat Standard Required Lbs.	No. of Cows.	Aver- age Milk Lbs.	% Test.	Aver- age B/Fat Lbs.	No. of Cows.	Aver- age Milk Lbs.	% Test.	Aver- age B/Fat Lbs.	No. of Cows.	Aver- age Milk Lbs.	% Test.	Aver- age B/Fat Lbs.	% Test.		
Mature	350	54	8,281	3.98	329.84	44	5,515	4.96	289.03	41	6,236	4.90	316.68	4.51		
Senior 4 years	330	15	6,884	4.27	294.09	4	6,818	5.33	265.73	10	7,741	5.44	421.34	4.84		
Junior 4 years	310	18	6,927	3.98	276.09	8	5,107	4.92	273.32	11	6,418	5.25	336.90	4.52		
Senior 3 years	290	20	7,401	4.02	299.89	9	7,096	5.46	293.12	11	6,255	5.28	330.32	4.59		
Junior 3 years	270	28	6,695	4.21	231.99	15	5,917	5.31	291.00	11	5,416	5.59	302.78	4.64		
Senior 2 years	250	29	6,770	4.09	276.95	12	5,136	5.37	269.01	11	5,736	5.35	306.97	4.54		
Junior 2 years	230	62	6,770	4.13	286.10	16	5,395	4.87	263.04	31	5,090	5.25	267.71	4.49		
Totals	...	226	7,205	4.08	294.17	108	5,791	5.0	289.80	126	6,008	5.22	313.84	4.50		

Table 5 shows a comparison between the production of all cows under test 150 days and over, with those which completed 273 days. Information is given according to breed and age class.

TABLE 5.

COMPARATIVE TABLE SHOWING AVERAGE PRODUCTION IN EACH AGE CLASS OF COWS UNDER TEST 150 DAYS OR OVER AND COWS COMPLETING 273 DAYS.

Age Class.	A.I.S.				Jersey.			
	Standard Butter Fat.	No. of Cows Tested 150 days or over.	Average Butter Fat.	No. of Cows Completing 273 days.	Average Butter Fat.	No. of Cows Tested 150 days or over.	Average Butter Fat.	No. of Cows Completing 273 days.
	lbs.		lbs.		lbs.		lbs.	
Mature	350	54	329.84	40	361.88	41	316.68	27
Senior 4 years	330	15	294.09	11	325.87	10	421.34	10
Junior 4 years	310	18	276.09	12	301.41	11	336.99	7
Senior 3 years	290	28	299.89	15	328.44	11	330.32	11
Junior 3 years	270	28	231.99	17	302.80	11	302.78	9
Senior 2 years	250	29	276.45	24	297.20	11	306.07	10
Junior 2 years	230	32	280.10	38	285.80	31	267.71	29

Age Class.	Guernsey.				All Breeds.			
	Standard Butter Fat.	No. of Cows Tested 150 days or over.	Average Butter Fat.	No. of Cows Completing 273 days.	Average Butter Fat.	No. of Cows Tested 150 days or over.	Average Butter Fat.	No. of Cows Completing 273 days.
	lbs.		lbs.		lbs.		lbs.	
Mature	350	44	289.03	33	311.89	139	313.04	100
Senior 4 years	330	4	363.75	4	333.75	29	347.58	25
Junior 4 years	310	8	251.48	4	268.15	37	288.87	23
Senior 3 years	290	9	368.12	9	368.12	40	323.61	35
Junior 3 years	270	15	291.00	14	289.73	54	288.73	40
Senior 2 years	250	12	269.01	9	291.33	32	281.45	43
Junior 2 years	230	16	263.04	14	276.84	109	274.07	101

In one or two cases the 273 day average is lower than that of cows tested 150 days or over; this is owing to the fact that in some instances cows tested less than 273 days still gave a high production.

In the Mature class the only breed to exceed standard in the 273 day average was the Australian Illawarra Shorthorn, while the Jersey breed exceeded standard in all other classes.

Of the 460 cows in the averages, 80% completed 273 days, compared with 72% the previous year.

Leading Sires.

The three leading sires for the year were "Mormoot Northwood Bean," owned by R. H. Rose & Son, "Wooroloo Red Baron," owned by Wooroloo Sanatorium Farm and "Tipperary Ace," owned by W. G. Burges.

The adjusted average production of the six best daughters in each case was 548.51 lbs., 447.21 lbs. and 431.15 lbs. of butter-fat respectively.

Details of the averages of the six best and all daughters are given in Table 6.

TABLE 6.
LEADING THREE SIREs.—1946-47.

Name of Bull.	Owner.	Sire.	Dam.	Average Production of six best daughters.		Number of daughters under test.	Average Production.	
				Without allowances (lbs. butter fat).	With allowances (lbs. butter fat).		Without allowances (lbs. butter fat).	With allowances (lbs. butter fat).
Mormoot Northwood Beau (Jersey) (17798)	R. H. Rose & Son	Glen Iris Golden Beau (14629)	Mormoot Northwood Madeira 7th (63202)	506.26	548.51	17	416.39	480.49
Woorloo Red Baron (A.I.S.) (6412)	Woorloo Sanatorium Farm	Parkview Guardian (2557)	Woorloo Bloomer (5218)	363.42	447.21	12	340.49	420.59
Tipperary Ace (A.I.S.) (6336)	W. G. Burges ...	Blacklands Monarch's Commander (1877)	Yallah Farm Maggie 2nd (1272)	388.78	431.15	15	307.86	362.90

TABLE 7. — AVERAGE PRODUCTION OF DAUGHTERS OF TEN SIREs, YEARS 1943-44 TO 1946-47.

Name of Bull.	Breed.	Sire.	Dam.	Average Production of six best daughters.		Number of daughters under test.	Average Production.	
				Without allowances (lbs. butter fat).	With allowances (lbs. butter fat).		Without allowances (lbs. butter fat).	With allowances (lbs. butter fat).
Mormoot Northwood Beau (17798)	Jersey ...	Glen Iris Golden Beau (14629)	Mormoot Northwood Madeira 7th (63292)	517.26	614.75	36	404.22	484.26
Austral Park Wonderful Standard (12423)	Jersey ...	Ellerdale Wonderful Masterman (11561)	Ellerdale Wonder's Golden (47992)	569.88	619.32	18	434.40	475.76
Grassvale Gold Boy (14684)	Jersey ...	Belgonia Gold Boy (12458)	Grassvale Lady Fowler 17th (48536)	481.47	540.67	23	416.40	459.73
Greenmount Golden Sultan (14688)	Jersey ...	Bellefaire Bonaparte's Bonetienne (9224)	Charming Lass of Greenmount (20903)	551.27	603.87	19	390.80	425.56
Koojan Beau Ideal (4965)	Guernsey ...	Glenburnie Ideal U.S.A. (2548)	Koojan Ace's Mignonette (3898)	475.04	536.76	17	353.37	414.69
Summerlea Churehill (6236)	A.I.S. ...	Summerlea Togo (1527)	Summerlea Empress 7th (14247)	341.33	428.90	18	306.45	384.42
Wooroloo Red Baron (6412)	A.I.S. ...	Parkview Guardian (2557)	Wooroloo Bloomer (5218)	354.61	458.92	22	307.41	383.71
Roscliff Marchalong (15094)	Jersey ...	Roscliff Flower's Bravo (12121)	Roscliff Viola (37771)	493.99	527.07	17	336.25	376.54
Homestead Ace (Imp.) U.S.A. (1631)	Guernsey ...	Archer of Cloture (Imp.) (133, 486)	Laddie's Blossom (118, 788)	398.13	486.01	16	320.72	373.02
Tipperary Ace (6336)	A.I.S. ...	Blacklands Monarch's Commander (1877)	Yallah Farm Maggie 2nd (1272)	393.95	441.61	26	293.04	357.75

TABLE 8.
THREE LEADING COWS IN EACH AGE CLASS.—1946-47.

Name of Cow.	Breed.	Herd Book No.	Date of Birth.	Date entered under Test.	No. of Days Test.	Milk Last Day of Test.	Total Milk Period.	Average Test.	Total Butter Fat for Period.	Owner.	Sire.
MATURE COWS—STANDARD 350 LB. BUTTER FAT.											
Glavanon Rosina ...	A.I.S.	30803	8-5-37	5-9-46	273	40	13,410	4.82	647.54	D. Bevan & Sons ...	Blacklands Jean's Supreme (1871)
Koojan Golden Jewel ...	Guernsey	8583	12-2-40	21-12-45	273	21	9,963	5.58	556.34	A. W. Padbury ...	Koojan Beau Ideal (4965)
Cougelin Iolanthe 8th ...	Jersey	85823	22-4-40	21-6-46	273	28.5	10,810	4.93	533.96	D. Bradford ...	Rosecliffe Marchalong (15094)
SENIOR FOUR YEAR OLDS—STANDARD 330 LB. BUTTER FAT.											
Grass Vale Buttercup 9th ...	Jersey	92713	24-5-41	7-5-46	273	24	9,852	6.02	593.91	R. H. Rose & Son ...	Grass Vale Gold Boy (14684)
Grass Vale Northwood Nora ...	do.	86046	23-5-41	31-3-46	273	19	8,172	5.97	532.70	R. H. Rose & Son ...	Mormoot Northwood Beau (17798)
Grass Vale Lady Fowler 83rd ...	do.	92716	7-7-41	5-6-46	273	21	9,168	5.55	509.23	R. H. Rose & Son ...	Mormoot Northwood Beau (17798)
JUNIOR FOUR YEAR OLDS—STANDARD 310 LB. BUTTER FAT.											
Grass Vale Northwood Eve ...	Jersey	92725	3-7-42	25-9-46	273	20	10,085	5.74	576.10	R. H. Rose & Son ...	Mormoot Northwood Beau (17798)
Grass Vale Northwood ...	A.I.S.	92724	27-6-42	9-8-46	273	18	7,674	5.40	414.42	R. H. Rose & Son ...	Mormoot Northwood Beau (17798)
Radyr Park Dorothy 10th ...	do.	95267	16-3-42	16-9-46	273	20	8,550	4.79	469.68	L. M. Temple ...	Nevva Coronation Star (14929)
SENIOR THREE YEAR OLDS—STANDARD 290 LB. BUTTER FAT.											
Koojan Noblemark's Beepie ...	Guernsey	...	19-12-42	6-10-46	273	20	10,557	5.46	577.07	A. W. Padbury ...	Koojan Ideal's Noblemark (5949)
Grass Vale Silvermine 2nd ...	Jersey	...	8-0-42	21-4-46	273	23	9,129	5.64	515.57	R. H. Rose & Son ...	Mormoot Northwood Beau (17798)
Koojan Are's Dianthus ...	Guernsey	10687	29-6-42	20-4-46	273	22	8,106	5.66	459.49	A. W. Padbury ...	Homestead Are (Imp.) (1631)
JUNIOR THREE YEAR OLDS—STANDARD 270 LB. BUTTER FAT.											
Grass Vale Golden Cream ...	Jersey	98525	3-8-43	8-10-46	273	20.5	7,591	5.87	444.51	R. H. Rose & Son ...	Mormoot Northwood Beau (17798)
26th ...	A.I.S.	...	25-2-43	20-6-46	210	24	10,920	3.46	378.72	C. P. House ...	Woorloo Noble 4th (6411)
Mayvale Golden Buttercup ...	Guernsey	10869	14-7-42	12-1-46	273	18	7,164	5.22	374.57	R. J. Gilles ...	Koojan Ideal's Discoverer (4968)
SENIOR TWO YEAR OLDS—STANDARD 250 LB. BUTTER FAT.											
Capel Dairymaid 6th ...	A.I.S.	...	18-6-43	1-6-46	273	37	12,686	2.80	499.26	B. W. Prowse ...	Capel Star King (4672)
Tipperary Dove 23rd ...	do.	...	7-4-43	2-3-46	273	36	10,068	4.03	442.38	W. G. Binges ...	Tipperary Ace (6236)
Grass Vale Magnolia 5th ...	Jersey	98526	16-10-43	2-9-46	273	21	8,088	5.98	435.83	R. H. Rose & Son ...	Grass Vale Gold Cup (20745)
JUNIOR TWO YEAR OLDS—STANDARD 230 LB. BUTTER FAT.											
Valliere Nina ...	A.I.S.	...	15-5-44	4-8-46	273	22	10,611	4.34	460.64	C. P. House ...	Woorloo Noble 4th (6411)
Capel Blue Pansy ...	do.	...	15-5-44	25-7-46	273	24.5	10,408	4.10	430.41	B. W. Prowse ...	Capel Star King (4672)
Grass Vale Eve ...	Jersey	...	19-9-43	25-2-46	273	23.5	6,955	6.04	420.29	R. H. Rose & Son ...	Mormoot Northwood Beau (17798)

Table 7 shows the performances of ten sires from 1943-44 to 1946-47. In each case the average productions of the six best and all daughters for the period is given.

The productions of the leading three cows in each age class are shown in Table 8.

Of the 21 cows whose productions are given in this table, it will be seen that one was over 600 lbs. butter-fat, 8 were over 500 lbs. butter-fat, ten were over 400 lbs. butter-fat, eleven of the twenty-one are Jerseys, six Australian Illawarra Shorthorns, and four Guernseys.

NEW RECORDS.

Two new records were established during the year:—

Junior 3-year-old Class—Guernseys.

"Koojan Noblemark's Bo-peep," owned by A. W. Padbury, produced 10,557 lbs. milk, average test 5.46% and 577.07 lbs. of butter-fat, thus exceeding the previous record of another cow of the same owner, viz., "Koojan Bo-peep 2nd," who in 1941 produced 9,639 lbs. milk, average test 5.69% and 548.93 lbs. of butter-fat.

The new record holder is by "Koojan Ideal's Noblemark" from "Koojan Ace's Barbara," the latter being out of "Koojan Bo-peep 2nd," the previous holder of this record.

The sire, "Koojan Ideal's Noblemark," is from "Koojan Ace's Jewel 2nd," the property of the same owner, and the holder of the following State records in the Mature Class:—Guernsey breed; West Australian-bred; and All Breeds. She produced 14,540 lbs. milk, average test 5.51% and 801.16 lbs. butter-fat.

Junior 2-year-old Class—Australian Illawarra Shorthorn.

"Valliere Nina," owned by C. P. House, of Ludlow, produced 10,611 lbs. milk, average test 4.34%, 460.64 lbs. butter-fat, exceeding the previous record held by "Glanavon Doris 7th," whose figures were 11,796 lbs. milk, average test 3.83% and 451.49 lbs. butter-fat.

"Valliere Nina" is by "Wooroloo Noble 4th" out of "Valliere Fairy 2nd."

The productions of all cows completing test during the year are shown in Table 9.

TABLE 9.
COWS WHICH COMPLETED TEST DURING THE TWELVE MONTHS ENDED 30TH JUNE, 1947.

Name of Cow.	Breed.	Herd Book No.	Date of Birth.	Date of Entry to Test.	No. of Tests in Test.	Weight of Milk Yielded for Test, lb.	Average Test, %	Weight of Butter Fat for Period, lb.	Owner.	Sire.
COWS UNDER 2½ YEARS—STANDARD 230 LB. BUTTER FAT.										
Valliere Nina	A.I.S.	...	15-5-44	4-8-46	273	10,611	4-34	460-64	C. P. House ...	Woorloo Noble 4th (6411)
Capel Blue Fanny	Jersey	...	15-5-44	25-7-46	273	24-5	4-10	430-41	B. W. Prowse ...	Capel Star King (4072)
Grass Vale Eve	A.I.S.	...	19-0-43	25-2-46	273	23-5	6-05	420-20	R. H. Rose & Son ...	Mornmoor Northwood Bean (17798)
Woorloo Trinet	A.I.S.	...	30-3-44	2-8-46	273	9,159	4-02	404-05	Woorloo Sanatorium Farm	Woorloo Red Baron (6412)
Tipperary Beauty 21st	do.	...	1-10-44	12-0-46	273	30	8-730	373-32	M. H. Montgomery ...	Liberton Venturer 2nd. (7132)
Woorloo Lorna	do.	...	6-4-44	2-10-46	273	29	8,397	372-84	Woorloo Sanatorium Farm	Woorloo Red Baron (6412)
Juadine Juliette 4th	Jersey	...	28-5-44	23-8-46	273	13-5	6,055	357-96	K. V. Gray ...	Juadine Northwood Bean (19670)
Capel Fairy's Fleck	A.I.S.	...	26-5-44	30-0-46	273	27-5	8,362	354-31	B. W. Prowse ...	Capel Dove King (5379)
Valliere Dabrynaid	do.	...	8-4-44	13-4-46	273	29	9,222	3-81	J. Bensted & Co. ...	Valliere Skipton (7639)
Woorloo Bertha	do.	...	26-7-44	25-0-46	273	21	8,193	345-72	Woorloo Sanatorium Farm	Woorloo Red Baron (6412)
Woorloo Rae	do.	...	9-5-44	26-7-46	273	22	8,121	344-43	Woorloo Sanatorium Farm	Woorloo Red Baron (6412)
Claremont Clara 23rd	do.	...	22-6-44	1-0-46	273	29	8,067	344-05	Claremont Hospital for Insane	Glanvon Dunster (9867)
Murek Dignity	Guernsey	...	17-0-44	9-8-46	273	24	7,332	340-40	Murek Agricultural College	Koojan Ideal's Dictator (4167)
Tipperary Beauty 20th	A.I.S.	...	3-8-44	10-0-46	273	22	7,326	335-28	M. H. Montgomery ...	Liberton Venturer 2nd (7132)
Juadine Queen 2nd	Jersey	...	2-1-44	25-5-46	273	14	5,442	334-04	K. V. Gray ...	Juadine Northwood Bean (19670)
Woorloo Red Gum 2nd	A.I.S.	...	5-5-44	14-8-46	273	23	7,029	334-30	Woorloo Sanatorium Farm	Woorloo Red Baron (6412)
Warralyn Marie 11th	Jersey	...	3-4-44	21-0-46	273	15-5	5,776	333-40	M. B. Skott ...	Juadine Sparkle's Wonder (18659)
Grass Vale Silvermine 4th	do.	...	29-0-44	10-10-46	273	14-5	6,208	332-33	R. H. Rose & Son ...	Mornmoor Northwood Bean (17798)
Murek Jessica	Guernsey	...	26-7-44	7-10-46	272	21	6,753	325-44	Murek Agricultural College	Koojan Ideal's Dictator (4167)
Woorloo Lady May 6th	A.I.S.	...	23-5-44	12-8-46	273	19	7,317	325-32	Woorloo Sanatorium Farm	Woorloo Red Baron (6412)
Murek Awas	Guernsey	...	25-5-44	31-5-46	273	17	6,951	324-66	Murek Agricultural College	Koojan Ideal's Dictator (4167)
Grass Vale Lady Fowler 39th	Jersey	...	30-9-43	2-11-45	273	21	6,093	323-47	R. H. Rose & Son ...	Mornmoor Northwood Bean (17798)
Claremont Mabel 31st	A.I.S.	...	3-1-44	11-6-46	273	27	7,551	318-99	Claremont Hospital for Insane	Sumneria Churchill (6238)
Claremont Treasure 40th	do.	...	11-1-44	6-7-46	273	27	7,911	318-85	Claremont Hospital for Insane	Westby Masterpiece (5403)
Grass Vale Magnolia 6th	Jersey	...	3-4-44	25-8-46	273	14	5,862	317-82	R. H. Rose & Son ...	Mornmoor Northwood Bean (17798)
Claremont Cocky 30th	A.I.S.	...	9-1-44	2-2-46	273	27	7,611	316-82	Claremont Hospital for Insane	Westby March (5404)

Kapara Sparkle 4th	Jersey	15-4-44	22-6-46	273	14-5	6,733	4-67	314-91	D. Bradford	Congelin Jolly Eminent 3rd (18425)
Mayville Discoverer's Daffodil	Guernsey	20-1-44	20-6-46	273	17	5,211	6-00	313-04	R. J. Giles	Koojan Ideal's Discoverer (4068)
Judine Peerless Lily 23rd	Jersey	27-4-44	6-8-46	273	17	6,066	5-11	310-57	M. B. Stott	Judine Northwood Beau (19070)
Carbanup Grace	A.I.S.	12-2-44	13-6-46	273	17-5	7,183	4-82	310-26	D. H. Bell	Glanvon Maestro (4833)
Claremont Pinafore 18th	do.	30-9-43	4-11-45	273	26	7,278	4-25	309-36	Claremont Hospital for Insane	Glanvon Dunster (6867)
Claremont Cocky 27th	do.	25-12-43	20-6-46	273	24	7,332	4-21	308-89	Claremont Hospital for Insane	Westby Monarch (5404)
Grass Vale Silvermine 3rd	Jersey	15-10-43	27-11-45	273	9	5,217	5-82	303-88	R. H. Rose & Son	Mormoot Northwood Beau (17798)
Claremont Treasure 43rd	A.I.S.	27-1-44	29-6-46	273	22	7,251	4-17	302-67	Claremont Hospital for Insane	Westby Monarch (5404)
Claremont Whitty Maid 58th	do.	2-1-44	1-5-46	273	25	7,425	4-06	301-74	Claremont Hospital for Insane	Westby Masterpiece (5403)
Claremont Star 33rd	do.	15-11-43	15-1-46	273	24	7,662	3-93	301-34	Claremont Hospital for Insane	Summerlea Churchill (6236)
Tipperary Dove 27th	do.	10-6-43	11-11-45	273	25	7,095	4-24	301-02	W. G. Burges	Tipperary Ace (6336)
Kapara Rosebud 2nd	Jersey	28-2-44	12-6-46	273	11-5	5,269	5-67	299-24	D. Bradford	Congelin Jolly Eminent 3rd (18425)
Mayvale Ideal's Daisy	Guernsey	30-7-44	22-6-46	273	16	7,386	5-11	298-80	R. J. Giles	Koojan Ideal's Discoverer (4068)
Claremont Poppy 35th	A.I.S.	10-4-44	29-7-46	273	25	7,200	4-13	297-77	Claremont Hospital for Insane	Glanvon Dunster (6867)
Claremont Star 34th	do.	4-1-44	24-2-46	273	25	7,215	4-09	295-35	Claremont Hospital for Insane	Summerlea Churchill (6236)
Brookfields Cremorne	Guernsey	17-7-43	9-11-45	273	13-5	5,215	5-65	294-70	P. G. Hampshire & Son	Varaview Julian (4634)
Claremont Mabel 29th	A.I.S.	9-10-43	30-1-46	273	25	7,305	4-00	292-77	Claremont Hospital for Insane	Westby Monarch (5404)
Tipperary Pretty Maid 3rd	do.	7-10-43	21-11-45	273	25	6,915	4-22	292-38	W. G. Burges	Tipperary Ace (6336)
Grassvale Lady Fowler 42nd	Jersey	27-8-44	25-8-46	273	12	5,361	5-40	289-79	K. V. Gray	Mormoot Northwood Beau (17798)
Wooroloo Ethel 2nd	A.I.S.	27-7-44	4-9-46	273	5	6,600	4-31	284-48	Wooroloo Sanatorium Farm	Wooroloo Red Baron (6412)
Kapara Sparkle's Lassie 3rd	Jersey	13-8-44	21-6-46	273	14	5,937	4-78	284-34	D. Bradford	Congelin Jolly Eminent 3rd (18425)
Lenmoor's Biddy 2nd	A.I.S.	7-7-44	6-7-46	273	12	7,131	3-92	280-14	G. W. Marston	Wooroloo Union Jack (7662)
Kapara Firefly 2nd	Jersey	8-8-44	21-6-46	273	15	5,970	5-65	277-78	D. Bradford	Congelin Mandarin (14542)
Yokanup Lupin 3rd	A.I.S.	27-5-44	28-7-46	273	14	7,482	3-65	273-41	Burkitt & Brown	Parkview Commodore (306)
Murek's Joan	Guernsey	10-6-44	13-7-46	273	17	6,291	4-31	271-74	Murek's Agricultural College	Koojan Ideal's Dictator (4167)
Claremont Treasure 42nd	A.I.S.	27-1-44	25-6-46	273	20	6,540	4-15	271-48	Claremont Hospital for Insane	Westby Monarch (5404)
Denmark Ruler's Rose	Guernsey	5-1-44	4-5-46	273	19	6,207	4-34	269-80	Denmark Marie's Ruler (5756)	
Kapara Dairymaid 2nd	Jersey	14-5-44	10-9-46	273	19-5	6,060	4-42	268-38	D. Bradford	Congelin Jolly Eminent 3rd (82073)
Tipperary Beauty 19th	A.I.S.	4-11-43	19-11-45	273	20	6,420	4-17	267-86	W. G. Burges	Tipperary Ace (6336)
Tipperary Fairy 10th	do.	26-10-43	7-11-45	273	21	6,702	3-99	267-81	W. G. Burges	Tipperary Ace (6336)
Claremont Belle 40th	do.	10-3-44	1-8-46	273	21	6,723	3-97	267-52	Claremont Hospital for Insane	Westby Masterpiece (5403)
Claremont Maggie Morriboon 61st	do.	9-1-44	21-6-46	273	23	6,600	4-05	267-38	Claremont Hospital for Insane	Westby Monarch (5404)
Claremont Poppy 34th	do.	22-2-44	12-6-46	273	16	5,928	4-50	266-96	Claremont Hospital for Insane	Summerlea Churchill (6238)
Claremont Cleggett 27th	do.	5-9-43	7-11-45	273	20	6,420	4-14	266-27	Claremont Hospital for Insane	Westby Masterpiece (5403)
Claremont Cherry 36th	do.	1-11-43	17-12-45	273	17	6,231	4-26	265-73	Claremont Hospital for Insane	Glanvon Dunster (6867)
Murek's Diadem	Guernsey	7-5-44	20-11-45	273	16	4,908	5-40	265-42	Murek's Agricultural College	Koojan Ace's Warspite (5943)

TABLE 9—HERD TESTING—continued.

Name of Cow.	Breed.	Herd Book No.	Date of Birth.	Date of Birth to Test.	No. of Days in Test.	Weight of Milk on Last Day of Test, lb.	Weight of Milk for Period, lb.	Average Test, %	Weight of Butter Fat for Period, lb.	Owner.	Sire.
COWS UNDER 2½ YEARS—STANDARD 230 Lb. BUTTER FAT—continued.											
Claremont Cherry 35th	A.I.S.	...	20-9-43	15-10-45	273	21	5,943	4.40	261.77	Claremont Hospital for Insane	Glanvion Dunster (6867)
Radry Park Dorothy 29th	Jersey	...	12-7-44	20-8-46	273	11	4,848	5.36	200.32	L. M. Temple	Radry Park Estrellita 2nd Star bright (21187)
Claremont Cockey 31st	A.I.S.	...	11-1-44	14-6-46	273	10	6,957	4.27	258.84	Claremont Hospital for Insane	Westby Monarch (5404)
Fungella Yileen	Jersey	...	27-4-44	2-5-46	273	12.5	5,632	4.50	258.63	D. G. Spark	Bungella Prince Starlight (19538)
Jennmoor's Peggy 2nd	A.I.S.	...	16-1-44	1-5-46	273	15	7,275	3.53	257.42	G. W. Marston	Fendale Radiant (5729)
Claremont Maggie Morrison 55th	do.	...	18-8-43	6-10-45	273	26	6,588	3.88	256.08	Claremont Hospital for Insane	Westly Masterpiece (5403)
Wooroloo Delys	do.	...	1-4-44	30-5-46	273	13	5,709	4.47	255.56	Wooroloo Sanatorium Farm	Wooroloo Top Gallant (7661)
Denmark Daffodil	Guernsey	...	21-4-44	30-5-46	273	14	4,707	5.35	251.86	Denmark Research Station	Koojan Ideal's Reflection (4974)
Denmark Bonnie Marie	do.	...	30-11-43	8-5-46	273	15	5,745	4.34	249.57	Denmark Research Station	Denmark Marie's Ruler (5750)
Claremont Clarie 3rd	A.I.S.	...	9-11-43	3-5-46	273	20	6,030	4.13	249.55	Claremont Hospital for Insane	Glanvion Dunster (6867)
Kapara Duchess 2nd	Jersey	...	18-6-44	9-6-46	273	12.5	5,332	4.67	249.13	D. Bradford	Congelin Jolly Emblem 3rd (18425)
Kapara Valentine	do.	...	18-3-44	20-6-46	273	13	5,286	4.60	243.69	D. Bradford	Kapara Cream Socks (20860)
Radry Park Dorothy 27th	do.	...	10-6-44	20-8-46	273	10	4,605	5.28	243.40	L. M. Temple	Radry Park Estrellita 2nd Star-light (21187)
Kapara Dalrymald 3rd	do.	...	4-8-44	24-6-46	273	11	4,818	5.03	242.73	D. Bradford	Congelin Mandarin (14542)
Wooroloo Bella 3rd	A.I.S.	...	23-0-43	3-10-45	273	16	5,613	4.27	241.08	Wooroloo Sanatorium Farm	Berry Rufus 2nd (6570)
Radry Park Dorothy 31st	Jersey	...	7-12-44	3-9-46	240	13	4,905	4.84	237.72	L. M. Temple	Radry Park Estrellita 2nd Star-light (21187)
Wattle Creek Valetta	A.I.S.	...	16-6-43	6-10-45	273	18	7,284	3.26	237.64	E. T. Thatcher	Wooroloo Royal Standard (6414)
Scotch College Flora McDonald	do.	...	1-6-44	21-7-46	210	21	6,210	3.80	236.40	J. Donistach & Co.	Claremont Signet (5590)
Rutherford Golden Butterfly	Guernsey	...	22-1-44	10-5-46	273	13.5	4,510	5.21	235.39	Misses E. & I. Rutherford	Denmark Golden Ruppel (5751)
Montaro Kitty	A.I.S.	...	10-9-44	14-9-46	273	8	4,704	4.96	233.71	M. H. Montgomery	Glanvion Tudor
Corbunup Gold	do.	...	1-3-44	21-8-46	240	2	5,805	4.02	233.49	D. H. Bell	Newstead Royal Sun (7252)
Tipperary Dove 28th	do.	...	1-8-43	25-11-45	273	16	5,778	4.01	232.81	W. G. Burges	Tipperary Ace (6836)
Tipperary Beauty 18th	do.	...	8-10-43	20-10-45	273	16	5,658	4.11	232.59	W. G. Burges	Tipperary Ace (6836)
Vallera Winnie	do.	...	10-4-44	31-3-46	273	19	5,397	4.24	232.14	J. Benstead & Co.	Valliere Skipton (7595)
Kapara Bo-Peep 2nd	Jersey	...	17-5-44	10-6-46	273	13	5,362	5.21	227.48	D. Bradford	Congelin Jolly Emblem 3rd (18425)
Korijekup Nadine	do.	...	23-11-43	19-2-46	273	14	4,362	5.21	227.48	Mrs. A. G. Eckerley	Madeline Captain Sun (7252)
Corbunup Gem	A.I.S.	...	19-6-44	12-6-46	273	8	5,439	4.18	227.30	Mrs. L. Bell	Newstead Royal Sun (7252)
Glovely Olive	Guernsey	...	30-6-44	12-6-46	273	8	4,059	5.49	222.68	Mrs. L. R. Barnshy	Denmark Rosa's Ace (5760)
Wattle Creek Glamour	A.I.S.	...	21-8-43	8-10-45	273	13	5,169	4.27	221.10	E. T. Thatcher	Wooroloo Royal Standard (6414)

		STANDARD 250 LB. BUTTER FAT.											
		COWS 24 YEARS AND UNDER 3 YEARS.											
		26-3-44	30-6-46	27-3	19	3-96	5,487	217-20	Claremont Hospital for Insane	3-96	5,487	217-20	Claremont Hospital for Insane
Claremont Biddy 76th	A.I.S.	26-3-44	30-6-46	27-3	19	3-96	5,487	217-20	Claremont Hospital for Insane	3-96	5,487	217-20	Claremont Hospital for Insane
Kapara Sparkle's Victorious 2nd	Jersey	29-5-44	21-6-46	27-3	8-5	5-13	4,135	212-26	Misses E. & L. Rutherford	5-13	4,135	212-26	Misses E. & L. Rutherford
Rutherford Golden Dawn	Guernsey	15-4-44	16-5-46	27-3	12-5	4-70	4,507	212-26	Misses E. & L. Rutherford	4-70	4,507	212-26	Misses E. & L. Rutherford
Claremont Pinafore 19th	A.I.S.	3-1-44	3-4-46	27-3	19	3-63	3,817	211-60	Claremont Hospital for Insane	3-63	3,817	211-60	Claremont Hospital for Insane
Colledale Lass	Jersey	12-6-44	10-5-46	27-3	9	4-78	4,347	207-85	C. E. Kruger	4-78	4,347	207-85	C. E. Kruger
Camden Calatira 2nd	do.	20-8-44	26-4-46	27-3	4	5-387	5,407	202-08	C. E. Kruger	5-387	5,407	202-08	C. E. Kruger
Woorloo Sally	A.I.S.	10-8-44	2-6-46	27-3	4	4-59	4,347	199-79	Woorloo Sanatorium Farm	4-59	4,347	199-79	Woorloo Sanatorium Farm
Lenmoor's Queen 5th	do.	20-6-44	1-5-46	27-3	10	3-20	6,120	196-45	G. W. Marston	3-20	6,120	196-45	G. W. Marston
Rosella Daffodil	Guernsey	7-8-44	12-8-46	180	14-5	3-70	3,510	186-21	Darnell Brothers	3-70	3,510	186-21	Darnell Brothers
Colledale Biddy	Jersey	20-6-44	21-2-46	27-3	14	5-01	3,405	185-48	C. E. Kruger	5-01	3,405	185-48	C. E. Kruger
Camden Belle 2nd	do.	17-4-43	13-5-46	240	7	3-255	3,405	183-09	C. E. Kruger	3-255	3,405	183-09	C. E. Kruger
Camden Venus 2nd	do.	5-2-45	28-7-46	27-3	4	3-817	3,817	178-96	C. E. Kruger	3-817	3,817	178-96	C. E. Kruger
Camden Sheila	A.I.S.	12-3-44	29-4-46	27-3	6	4-533	4,533	168-00	J. Beust & Co.	4-533	4,533	168-00	J. Beust & Co.
Scott College Peggy 3rd	do.	14-6-43	28-11-46	27-3	6	4-251	4,251	164-97	W. G. Dun School of Agriculture	4-251	4,251	164-97	W. G. Dun School of Agriculture
Tipperary Ace	do.	13-11-43	13-4-46	180	6	3-165	3,165	161-94	Narraggin	3-165	3,165	161-94	Narraggin
Narraggin Diana	do.	12-2-44	20-11-45	240	12	4-11	3,840	158-10	E. R. Thatcher	4-11	3,840	158-10	E. R. Thatcher
Wattle Creek Dixie	Guernsey	23-9-44	3-9-46	150	12-5	5-75	2,550	149-73	Darnell Brothers	5-75	2,550	149-73	Darnell Brothers
Rosella Matilda	do.	2-11-44	27-8-46	120	13	5-24	2,550	118-72	Darnell Brothers	5-24	2,550	118-72	Darnell Brothers
Rosella Gloria	do.	9-9-44	19-8-46	120	17	7-48	1,530	114-48	P. G. Hampshire & Son	7-48	1,530	114-48	P. G. Hampshire & Son
Brookfields Betty 4th	do.	30-5-44	19-8-46	90	10	2-160	4-229	82-70	W. K. Barnes	2-160	4-229	82-70	W. K. Barnes
Roseland Jolly 9th	A.I.S.	25-10-44	13-4-46	120	10	1-890	4-775	80-79	Mrs. A. G. Eckersley	1-890	4-775	80-79	Mrs. A. G. Eckersley
Korjefek Lady Star	Jersey	20-1-44	13-4-46	120	10	1-575	4-775	67-41	C. J. Cunningham	1-575	4-775	67-41	C. J. Cunningham
Valgeek Handsome Girl 40th	do.	13-4-44	22-11-46	100	10	1-380	4-230	59-22	Narraggin School of Agriculture	1-380	4-230	59-22	Narraggin School of Agriculture
Narraggin Dell	A.I.S.	17-4-44	30-5-46	150	8	9-15	915	45-87	P. G. Hampshire & Son	9-15	915	45-87	P. G. Hampshire & Son
Brookfields Betty 2nd	Guernsey	4-3-44	26-8-46	60	14-5	9-00	900	38-52	Claremont Hospital for Insane	9-00	900	38-52	Claremont Hospital for Insane
Claremont Maggie Morrison 60th	A.I.S.	9-1-44	18-6-46	60	16	3-63	370	20-70	Claremont Hospital for Insane	3-63	370	20-70	Claremont Hospital for Insane
Claremont Flora 14th	do.	1-3-44	13-6-46	30	19								
COWS 24 YEARS AND UNDER 3 YEARS.—STANDARD 250 LB. BUTTER FAT.													
Capel Dairymaid 6th	A.I.S.	18-0-43	1-6-46	27-3	37	12-836	3-80	492-36	B. W. Prowse	12-836	3-80	492-36	B. W. Prowse
Tipperary Dove 23rd	do.	7-4-43	2-3-46	27-3	36	10-868	4-03	442-38	W. G. Burges	10-868	4-03	442-38	W. G. Burges
Grass Vale Magnolia 5th	Jersey	16-10-43	2-9-46	27-3	21	2-087	5-38	435-35	R. H. Rose & Son	2-087	5-38	435-35	R. H. Rose & Son
Kooljan Ace's Diplomat	Guernsey	28-8-43	26-8-46	27-3	19	7-688	5-50	411-14	A. W. Padbury	7-688	5-50	411-14	A. W. Padbury
Grass Vale Design's Noella	Jersey	20-10-43	17-9-46	27-3	13-5	7-688	5-50	407-61	R. H. Rose & Son	7-688	5-50	407-61	R. H. Rose & Son
Grass Vale Lady Fowler 30th	A.I.S.	30-9-43	22-9-46	27-3	19	8-238	5-56	393-21	D. H. Bell	8-238	5-56	393-21	D. H. Bell
Grass Vale Lady Star	do.	29-6-43	3-3-46	27-3	9-5	8-238	5-56	385-84	D. H. Bell	8-238	5-56	385-84	D. H. Bell
Carbunup Flirt	Jersey	4-5-43	2-4-46	27-3	18	6-769	4-67	370-70	J. R. Gilles	6-769	4-67	370-70	J. R. Gilles
Landowne Virtue	Guernsey	30-4-43	2-4-46	27-3	18	6-669	5-47	365-18	W. G. Burges	6-669	5-47	365-18	W. G. Burges
Landowne Blossom 5th	A.I.S.	26-10-43	31-5-46	27-3	26	8-958	4-01	359-45	W. G. Burges	8-958	4-01	359-45	W. G. Burges
Greyfriar Precious Gem	do.	2-9-43	20-7-46	27-3	16	8-118	4-23	344-06	R. H. Rose & Son	8-118	4-23	344-06	R. H. Rose & Son
Grass Vale Nutcracker 14th	Jersey	7-9-43	17-8-46	27-3	10	5-895	5-75	338-97	W. G. Burges	5-895	5-75	338-97	W. G. Burges
Woorloo Vandy 2nd	A.I.S.	9-11-43	18-5-46	27-3	22	7-236	4-65	337-04	W. G. Burges	7-236	4-65	337-04	W. G. Burges
Tipperary Dove 25th	do.	6-5-43	14-11-45	27-3	33	7-989	4-15	331-55	W. G. Burges	7-989	4-15	331-55	W. G. Burges
COWS 24 YEARS AND UNDER 3 YEARS.—STANDARD 250 LB. BUTTER FAT.													
Capel Dairymaid 6th	A.I.S.	18-0-43	1-6-46	27-3	37	12-836	3-80	492-36	B. W. Prowse	12-836	3-80	492-36	B. W. Prowse
Tipperary Dove 23rd	do.	7-4-43	2-3-46	27-3	36	10-868	4-03	442-38	W. G. Burges	10-868	4-03	442-38	W. G. Burges
Grass Vale Magnolia 5th	Jersey	16-10-43	2-9-46	27-3	21	2-087	5-38	435-35	R. H. Rose & Son	2-087	5-38	435-35	R. H. Rose & Son
Kooljan Ace's Diplomat	Guernsey	28-8-43	26-8-46	27-3	19	7-688	5-50	411-14	A. W. Padbury	7-688	5-50	411-14	A. W. Padbury
Grass Vale Design's Noella	Jersey	20-10-43	17-9-46	27-3	13-5	7-688	5-50	407-61	R. H. Rose & Son	7-688	5-50	407-61	R. H. Rose & Son
Grass Vale Lady Fowler 30th	A.I.S.	30-9-43	22-9-46	27-3	19	8-238	5-56	393-21	D. H. Bell	8-238	5-56	393-21	D. H. Bell
Grass Vale Lady Star	do.	29-6-43	3-3-46	27-3	9-5	8-238	5-56	385-84	D. H. Bell	8-238	5-56	385-84	D. H. Bell
Carbunup Flirt	Jersey	4-5-43	2-4-46	27-3	18	6-769	4-67	370-70	J. R. Gilles	6-769	4-67	370-70	J. R. Gilles
Landowne Virtue	Guernsey	30-4-43	2-4-46	27-3	18	6-669	5-47	365-18	W. G. Burges	6-669	5-47	365-18	W. G. Burges
Landowne Blossom 5th	A.I.S.	26-10-43	31-5-46	27-3	26	8-958	4-01	359-45	W. G. Burges	8-958	4-01	359-45	W. G. Burges
Greyfriar Precious Gem	do.	2-9-43	20-7-46	27-3	16	8-118	4-23	344-06	R. H. Rose & Son	8-118	4-23	344-06	R. H. Rose & Son
Grass Vale Nutcracker 14th	Jersey	7-9-43	17-8-46	27-3	10	5-895	5-75	338-97	W. G. Burges	5-895	5-75	338-97	W. G. Burges
Woorloo Vandy 2nd	A.I.S.	9-11-43	18-5-46	27-3	22	7-236	4-65	337-04	W. G. Burges	7-236	4-65	337-04	W. G. Burges
Tipperary Dove 25th	do.	6-5-43	14-11-45	27-3	33	7-989	4-15	331-55	W. G. Burges	7-989	4-15	331-55	W. G. Burges

Glanvau Dunster (6867)

Congelin Jolly Eminent 3rd (18425)

Denmark Golden Rippler (5751)

Westly Monarch (5404)

Belgonia Peggy 6th's Aim (17263)

Greenmount Starbright (20748)

Woorloo Top Gallant (7661)

Woorloo Union Jack (7662)

Cranbourne Charlie (3983)

Belgonia Peggy 6th's Aim (17263)

Camden Rajah (19423)

Greenmount Starbright (20748)

Greenmount Starbright (20748)

Claremont Signet (5590)

Tipperary Ace (6356)

Tipperary Amy's Mascot (6338)

Glanvau Duncan (3993)

Cranbourne Charlie (3983)

Cranbourne Charlie (3983)

Yarraview Julian (634)

Wallath Dunrobin (6370)

Navia Royal Star (15869)

Selsey Wyandott's Prince (18058)

Tipperary Amy's Mascot (6338)

Yarraview Julian (3404)

Westly Monarch (6867)

Glanvau Dunster (6867)

Capel Star King (4672)

Tipperary Ace (6336)

Grass Vale Gold Cup (20745)

Horseshoe Ace (Imp.) (1631)

Mornmont Northwood Beau (17798)

Mornmont Northwood Beau (17798)

Newstead Royal Sun (7252)

Travelan Starbright King (18120)

Kooljan Beau Ideal (4965)

Swanlea Monarch 2nd (7514)

Swanlea Bertie (5290)

Grass Vale Gold Cup (20745)

Betty Rufus 2nd (6576)

Tipperary Ace (6336)

TABLE 9.—HERD TESTING—continued.

Name of Cow.	Breed.	Herd Book No.	Date of Birth.	Date of Entry to Test.	No. of Days in Test.	WEIGHT UNDER 2½ YEARS AND UNDER 3 YEARS—STANDARD 250 LB. BUTTERFAT—continued.			Owner.	Sire.
						Weight of Milk on Last Day of Test, lb.	Average Test, %	Weight of Butter Fat for Period, lb.		
Carburup Fay	A.I.S.	...	17-8-43	21-6-46	273	9.5	7.978	4.05	D. H. Bell	Newsstead Royal Sun (7252)
Wooroloo Golden Dawn	do.	...	17-10-43	12-8-46	273	23	7.164	4.47	Wooroloo Sanatorium Farm	Berry Rufus 2nd (6570)
Camden Celeste	Jersey	...	10-9-43	10-5-46	273	9	5.202	0.409	D. G. Spark	Greenmount Golden Bobbie (18578)
Tipperary Beauty 17th	A.I.S.	...	1-4-43	20-10-45	273	16	7.008	4.31	W. G. Burges	Tipperary Ace (6336)
Carburup Fussy	Guernsey	...	22-8-43	3-7-46	273	9.5	7.228	4.20	D. H. Bell	Glanavon Maestro (4833)
Carburup Gwendia	...	...	3-5-43	23-12-45	273	21	6.183	4.70	Muresk Agricultural College	Koojan Ideal's Dictator (4167)
Muresk Lady Bonnie	do.	...	19-9-43	20-3-46	273	19	5.517	5.34	Muresk Agricultural College	Koojan Ideal's Dictator (4167)
Wattle Creek Bluebell	A.I.S.	28485	29-10-43	21-9-46	273	20	6.360	4.58	E. T. Thatcher	Wooroloo Royal Standard (6414)
Carburup Fancy	do.	...	15-3-43	28-2-46	273	21	7.308	3.85	D. H. Bell	Newsstead Royal Sun (7252)
Tipperary Lady May 6th	do.	...	8-5-43	7-12-45	273	26	6.078	4.40	W. G. Burges	Tipperary Ace (6336)
Denmark Dawn's Reflection-ette	Guernsey	...	7-9-43	12-5-46	273	13	5.150	5.38	Denmark Research Station	Koojan Ideal's Reflection (4074)
Clovelly Hazel	do.	...	14-8-43	10-7-46	273	9	5.307	5.13	Mrs. R. Barnish	Lansdowne Polydymite (4905)
Trano Kedomia 2nd	A.I.S.	...	12-2-43	2-2-46	273	24	6.852	3.03	J. Ransford & Co.	Chatterbox Prince (3800)
Travalgan Starlight 22nd	Jersey	...	18-6-43	13-6-46	273	11	4.908	5.48	K. V. Gray	Travalgan Oxford's King (19160)
Muresk Susannah	Guernsey	...	20-11-43	6-7-46	273	12	5.406	4.88	Muresk Agricultural College	Koojan Ideal's Dictator (4074)
Narrogin Charmer	A.I.S.	...	2-8-43	20-4-46	273	12	5.976	4.17	Narrogin School of Agriculture	Tipperary Amy's Mascot (6338)
Claremont Biddy 75th	do.	...	6-2-44	28-9-46	273	22	6.636	3.73	Claremont Hospital for Insane	Westly Masterpiece (5403)
Glanavon Fairy 8th	do.	...	24-3-43	19-10-45	273	12	5.406	4.46	D. Bevan & Sons	Blacklands Jean's Supreme (1871)
Camden Selena	Jersey	...	28-9-43	24-5-46	273	8	4.344	5.46	D. G. Spark	Greenmount Golden Bobbie (18578)
Narrogin Duchess	A.I.S.	...	23-1-44	29-10-46	273	17	5.856	3.93	Narrogin School of Agriculture	Tipperary Amy's Mascot (6338)
Yokanup Daphne 2nd	do.	...	10-10-43	9-7-46	273	11	5.913	3.84	Burkitt & Brown	Parkview Commodore (306)
Claremont Bell 35th	do.	...	26-1-44	11-8-46	273	17	5.871	3.86	Claremont Hospital for Insane	Westly Masterpiece (5403)
Wattle Creek Birle	do.	...	21-9-43	10-7-46	273	7	5.361	4.21	E. T. Thatcher	Wooroloo Royal Standard (6414)
Clovelly Diamond	Guernsey	...	10-6-43	6-6-46	240	14	4.740	4.70	Mrs. I. R. Barnish	Lansdowne Polydymite (4905)
Bessie Bloom	do.	...	1-9-43	6-7-46	210	11.5	4.665	4.79	Darnell Brothers	Cranbourne Charlie (3993)
Denmark Ace's Biarrette	do.	...	9-8-43	20-4-46	273	12.5	3.922	5.61	Denmark Research Station	Tipperary Ace (6336)
Wallett Ranunculus	Jersey	...	26-5-43	20-3-46	273	8	4.824	4.51	C. J. Cunningham	Selsey Wyandotte's Prince (18058)
Narrogin Flo	A.I.S.	...	6-4-43	15-3-46	240	14	6.240	3.49	Narrogin School of Agriculture	Tipperary Amy's Mascot (6338)
Rosella Pauline	Guernsey	...	8-8-43	20-5-46	273	11	4.188	5.15	Darnell Brothers	Cranbourne Charlie (3993)
Horsford Society 4th	do.	...	17-1-44	8-8-46	180	13	5.330	3.99	W. K. Barnes	Wooroloo Red Lad (5418)
Tipperary Dove 22nd	do.	...	20-3-43	2-12-45	273	10	5.340	3.94	W. G. Burges	Tipperary Ace (6336)
Wattle Creek Phyllis	do.	...	13-5-43	21-12-45	273	16	4.908	4.26	E. T. Thatcher	Wooroloo Royal Standard (6414)

COWS 3 YEARS AND UNDER ½ YEARS.—STANDARD 270 LB. BUTTERFAT.									
Jersey A.I.S.	1-5-43 10-6-43	3-5-46 20-3-46	273 240	0-5 12	4-48 4-065	4-08 3-83	207-71 173-85	C. J. Cunningham Narrogin School of Agriculture	Selsey Wyandottes Prince (18058) Tipperary Amy's Mascot (6338)
Camden Milkmaid	9-12-43	28-7-46	273	6	3-498	5-0	175-18	Greenmount Starbright (20748)	
Clenovilly Glory	30-8-43	3-6-46	240	6-5	3-045	5-27	160-50	Lansdowne Polydrome (4995)	
Leunover's Rosy	21-8-43	21-6-46	150	12	4-095	3-79	155-28	Ferradale Radiant (5729)	
Roseella Pearl	27-8-43	19-7-46	120	15	2-550	5-21	133-48	Carbounne Charlie (3993)	
Narrogin Dora	1-7-43	13-3-46	240	6	3-315	3-97	131-85	Tipperary Amy's Mascot (6338)	
Walgett Handsome Girl 37th	18-4-43	6-12-46	120	15-5	2-355	4-07	110-04	Selsey Wyandottes Prince (18058)	
Roseella Ladybird	29-11-43	2-10-46	120	8-5	2-325	4-47	104-13	Carbounne Charlie (3993)	
Brookfields Juliette	22-10-43	11-7-46	120	10	1-515	5-54	84-03	Yarraview Julian (4034)	
Narrogin Dorothea	8-6-44	19-2-47	90	10	1-580	3-95	54-40	Tipperary Amy's Mascot (6338)	
Narrogin Clarice	4-4-44	11-3-47	60	19	1-275	3-24	41-40	Tipperary Amy's Mascot (6338)	
Penarbor Duffdill	22-4-44	23-11-46	30	22-5	6-75	3-64	24-57	Glanavon Genius (3957)	
COWS 3 YEARS AND UNDER ½ YEARS.—STANDARD 270 LB. BUTTERFAT.									
Jersey A.I.S.	3-8-43	8-10-46	273	20-5	7-501	5-87	444-51	R. H. Rose & Son	Mortmoor Northwood Beau (17708)
Valiere Emma	25-3-43	20-6-46	210	24	10-920	3-46	378-72	C. P. House	Wooroloo Noble 4th (6411)
Mayvale Golden Buttercup 2nd	14-7-42	12-1-46	273	18	7-104	5-22	374-57	R. J. Giles	Kooljan Ideal's Discoverer (4968)
Junaline Fairy	12-0-43	2-7-46	273	5	5-835	5-33	369-02	K. V. Gray	Junaline Northwood Beau (19670)
Carbounne Ploss	22-4-43	3-7-46	240	1	8-325	4-36	363-12	D. H. Bell	Newstead Royal Sun (7252)
Tipperary Beauty 15th	15-10-42	9-3-46	273	27	8-691	4-12	358-77	W. G. Burgess	Tipperary Ace (6336)
Glanavon Fairy 9th	3-5-43	4-7-46	273	19	8-307	4-20	356-43	D. Bevan & Sons	Blacklands Monarch's Commander (1877)
Capel Princess 8th	24-7-43	8-8-46	180	41	8-820	4-02	354-99	B. W. Prowse	Capel Star King (4672)
Travalkan Lady Elton 17th	29-5-43	5-7-46	273	11	5-133	6-77	347-89	K. V. Gray	Orplange Doughts (18919)
Tipperary Beauty 16th	22-11-42	23-12-45	273	26	7-908	4-39	347-45	W. G. Burgess	Tipperary Ace (6336)
Denmark Bonnie Princess	28-11-42	25-5-46	273	28	2-799	4-72	344-66	Denmark Research Station	Kooljan Ideal's Reflection (4974)
Capel Dove 2nd	18-5-43	25-3-46	273	19	7-962	4-25	338-42	B. W. Prowse	Capel Lottie's Reward (3782)
Bongalla Teopija	20-5-43	8-6-46	273	8-5	3-807	5-84	337-37	D. G. Stark	Travalkan Starbright King (18129)
Wooroloo Red Gum	18-4-43	13-0-46	273	10	7-728	4-34	335-49	Wooroloo Sanatorium Farm	Wooroloo Red Baron (6412)
Wooroloo Gail	28-2-43	1-4-46	273	10	7-290	4-55	332-22	Wooroloo Sanatorium Farm	Wooroloo Red Baron (6412)
Wooroloo Polly 3rd	6-6-43	21-8-46	273	10	7-155	4-02	330-82	Wooroloo Sanatorium Farm	Berry Rufus 2nd (6570)
Muresk Anna	28-9-42	14-12-45	273	24	7-332	4-50	330-33	Muresk Agricultural College	Kooljan Ideal's Dictator (4167)
Muresk Delicia's Pride	11-6-43	27-7-46	273	17	6-801	4-82	327-84	Muresk Agricultural College	Kooljan Ace's Warspite (3943)
Wooroloo Sunlady 5th	23-4-43	1-9-46	273	19	6-807	4-04	318-69	Wooroloo Sanatorium Farm	Berry Rufus 2nd (6570)
Carbounn Fragrance	10-2-43	27-4-46	240	16	6-915	4-57	316-68	D. H. Bell	Newstead Royal Sun (7252)
Radyr Park Estrellita 5th	1-8-43	20-8-46	273	8	5-244	6-03	316-43	L. M. Temple	Navua September Lad (14025)
Lockridge Marina	25-8-42	11-2-46	273	29	6-183	5-10	315-56	R. J. Giles	Kooljan Beau Geste (4964)
Mayvale Daphne	4-1-43	18-1-46	273	9-5	6-043	5-19	315-56	R. J. Giles	Kooljan Ideal's Discoverer (4968)
Mayvale Golden Diana	6-9-42	18-10-45	273	16	4-999	4-99	309-77	R. J. Giles	Kooljan Ideal's Discoverer (4968)
Lansdowne Ideal's Pride	9-1-43	6-4-46	240	18-5	5-798	5-33	308-64	J. R. Giles	Kooljan Beau Ideal (4965)
Radyr Park September's Estrellita	22-6-43	17-8-46	273	10	5-223	5-85	305-96	L. M. Temple	Navua September Lad (14029)

TABLE 9.—HERD TESTING—continued.

Name of Cow.	Breed.	Herd Book No.	Date of Birth.	Date of Entry to Test.	No. of Days in Test.	Weight of Milk on Last Day of Test, lb.	Weight of Milk for Period, lb.	Average %	Weight of Butter for Period, lb.	Owner.	Sire.
COWS 3 YEARS AND UNDER 3½ YEARS—STANDARD 270 LB. BUTTERFEAT											
Claremont Treasure 33rd	A.I.S.	...	21-9-42	23-10-45	273	23	7,809	3.87	302.28	Claremont Hospital for Insane	Summerlea Churchill (6236)
Kajara Iolanthe	Jersey	...	2-5-43	21-8-46	273	18	6,654	4.46	237.22	D. Bradford	Congelin Jolly Ennismeth 3rd (18425)
Woorloo Emerald	A.I.S.	...	30-11-42	10-1-46	273	14	6,372	4.00	233.22	Woorloo Sanatorium	Woorloo Red Baron (6412)
Carbunup Freda	do.	...	8-7-43	9-8-46	240	7.5	7,380	3.91	288.03	D. H. Bell	Newstead Royal Sun (7252)
Claremont Mabel 27th	do.	...	24-11-42	27-12-45	273	26	7,248	3.97	288.04	Claremont Hospital for Insane	Summerlea Churchill (6236)
Woorloo Heatherbell 2nd	do.	...	11-9-42	18-1-46	273	18	6,444	4.45	287.06	Woorloo Sanatorium	Berry Rufus 2nd (6570)
Carbunup Fuchsia	do.	...	10-2-43	28-5-46	273	8	6,849	4.11	281.92	D. H. Bell	Newstead Royal Sun (7252)
Woorloo Patsy	do.	...	9-9-42	21-12-45	273	6	6,123	4.60	281.71	Woorloo Sanatorium	Berry Rufus 2nd (6570)
Clovelly Primrose	Guernsey	10245	30-6-42	30-9-45	273	14	5,487	5.05	277.59	Mrs. L. R. Barnsly	Koojan Monogram (4174)
Ghanavon Rose 3rd	A.I.S.	...	23-4-42	13-10-45	273	14	6,012	4.52	271.91	D. Bevan & Sons	Blacklands Monarch's Commander (1877)
Clovelly Melba	Guernsey	...	21-6-43	6-7-46	273	10	5,595	4.76	266.80	Mrs. L. R. Barnsly	Landsdowne Polydymite (4095)
Rutherford Daffodil	do.	...	18-5-43	24-6-46	273	10.5	5,320	4.94	263.52	Misses E. & I. Rutherford	Rutherford Robin Adair (5238)
Clovelly Cherry	do.	10239	24-8-42	6-10-45	273	9	4,812	5.46	263.12	Mrs. L. R. Barnsly	Koojan Monogram (4174)
Carbunup Floxy	A.I.S.	...	19-2-43	11-5-46	240	2.5	6,000	4.18	254.88	D. H. Bell	Newstead Royal Sun (7252)
Walgett Handsome Girl 32nd	Jersey	...	21-4-43	30-5-46	240	12	4,680	5.29	247.98	C. J. Cunningham	Selsey Wyandottes Prince (18058)
Denmark Reflection's Dame	Guernsey	...	15-2-43	2-6-46	273	11.5	5,194	5.73	245.43	Denmark Research Station	Koojan Ideal's Reflection (4974)
Walgett Handsome Girl 31st	Jersey	...	20-1-43	1-5-46	273	12	5,196	4.33	225.34	C. J. Cunningham	Selsey Wyandottes Prince (18058)
Ghanavon Doris 14th	A.I.S.	...	21-5-42	12-10-45	273	7	5,541	4.03	223.63	D. Bevan & Sons	Newstead Triumph (3420)
Kajara Bo-Peep	Jersey	...	17-5-43	17-6-46	273	4.5	4,753	4.66	221.80	D. Bradford	Congelin Jolly Ennismeth 3rd (82073)
Judaine March Flower 2nd	do.	...	30-9-43	15-10-46	180	8.5	3,495	6.17	215.79	J. P. Smith	Judaine Northwood Beau (19670)
Denmark Orange Pekette	Guernsey	...	12-6-43	17-7-46	273	3	4,629	4.59	212.49	Denmark Research Station	Koojan Ideal's Reflection (4974)
Rutherford Annie	do.	...	7-5-43	28-6-46	273	12	4,371	4.82	210.74	Misses E. & I. Rutherford	Rutherford Robin Adair (5238)
Planarbor Daphne	A.I.S.	...	19-6-43	10-8-46	273	9.5	4,948	4.02	199.06	Mrs. V. Alexander	Ghanavon Genius (3957)
Ghanavon Ettie 4th	do.	...	18-10-42	24-2-46	240	6	4,200	4.45	186.03	D. Bevan & Sons	Ghanavon Federal (6869)
Lenmoor's Roma	do.	...	10-8-43	7-9-46	150	12	4,290	4.01	170.88	W. K. Barnes	Ferndale Radiant (5729)
Flenarbor Gwen	do.	...	31-6-42	29-11-45	210	11.5	4,575	3.59	164.64	Mrs. V. Alexander	Ghanavon Genius (3957)
Carydale Roberta	do.	...	13-3-43	4-5-46	180	12	3,660	3.89	142.65	M. H. Montgomery	Summerlea Robin Hood (5261)
Ghanavon Gwen 3rd	do.	...	29-6-43	18-10-46	150	13	3,180	3.96	126.06	Burkitt & Brown	Blacklands Monarch's Commander (1877)
Landsdowne Ideal's Dainty	Guernsey	...	22-2-43	19-8-46	90	27	2,520	4.30	108.45	J. R. Giles	Koojan Beau Ideal (4965)
Ghanavon Esmeralda 4th	A.I.S.	...	16-11-42	22-4-46	90	24	2,310	4.59	106.11	D. Bevan & Sons	Blacklands Monarch's Commander (1877)
Narrogin Charmer	do.	...	2-8-43	1-2-47	120	13	2,640	3.52	93.19	Narrogin School of Agriculture	Tipperary Amy's Mascot (6338)

COWS 3½ YEARS AND UNDER 4 YEARS.—STANDARD 290 LB. BUTTERFAT.											
Guernsey A.I.S.	Brookfields Gillian Narragin Diana	...	4-8-43 13-11-43	14-7-46 14-2-47	120 90	13-5 15	1,920 1,935	4-31 3-95	82-83 76-49	P. G. Hampshire & Son Narragin School of Agriculture	Varaview Hillan Tipperary Amy's Mascot (4634)
Guernsey	Koojan Noblemark's Bo-Prep	...	10-12-42	6-10-46	273	29	10,557	5-46	577-07	A. W. Padbury	Koojan Ideal's Noblemark (3949)
Jersey	Grass Vale Silvermine 2nd	...	8-9-42	21-4-46	273	23	9,129	5-04	515-57	R. H. Rose & Son	Montmore Northwood Beau (17738)
Guernsey	Koojan Ace's Dianthus	10687	29-6-42	29-4-46	273	25	8,106	3-99	439-40	A. W. Padbury	Hamstead Ace (Imp.) (1631)
Jersey	Grass Vale Buttercup 11th	...	3-7-46	3-7-46	273	16	7,218	6-05	436-71	R. H. Rose & Son	Montmore Northwood Beau (17738)
Guernsey	Denmark Reflectionette	...	13-11-42	19-10-46	273	18	7,329	5-77	432-21	Denmark Research Station	Koojan Ideal's Reflection (4074)
A.I.S.	Claremont Maggie Morrison 48th	...	6-8-42	9-4-46	273	34	11,292	3-76	421-24	Claremont Hospital for Insane	Summerlea Churchill (6236)
do.	Claremont Whibby Maid 48th	...	8-1-42	30-11-45	273	33	10,500	3-86	405-66	Claremont Hospital for Insane	Westly Monarch (5404)
do.	Kiama Princess 6th	...	9-10-42	31-8-46	273	10	7,800	4-08	393-55	M. H. Montgomery	Liberton Patriot 6th (4134)
do.	Lennox's Bluebell	37898	12-4-46	12-4-46	273	22-5	10,492	3-99	387-70	G. W. Marston	Ferndale Memento (3194)
Guernsey	Lansdowne Bonnie Elizabeth	...	1-6-42	13-8-46	273	20-5	7,516	5-07	381-17	J. R. Giles	Koojan Beau Ideal (4905)
Jersey	Kapara Velvetene	98311	23-5-42	23-5-46	273	17	7,410	5-11	379-45	D. Bradford	Congelin Mandarin (14542)
A.I.S.	Tipperary Early 9th	...	27-9-42	21-6-46	273	14	8,712	4-26	371-32	W. G. Burges	Tipperary Ace (6386)
do.	Wooroloo Wynette	41212	2-4-42	6-4-46	273	9	8,127	4-40	358-38	Wooroloo Sanatorium Farm	Wooroloo Red Baron (6412)
do.	Wooroloo Gladys 2nd	...	3-2-42	17-10-45	273	22	8,106	4-36	354-20	Wooroloo Sanatorium Farm	Wooroloo Red Baron (6412)
Guernsey	Clovelly Lily	10244	25-8-42	28-7-46	273	12	6,568	8-83	352-11	Mrs. L. R. Barnshy	Lansdowne Polydymite (4995)
do.	Lansdowne Ideal's Joybell	...	21-11-42	22-7-46	273	15	7,005	5-08	349-09	J. R. Giles	Koojan Beau Ideal (4905)
do.	Denmark Lady Dianna 2nd	...	29-10-42	9-10-46	273	13	5,811	4-85	340-43	Denmark Research Station	Denmark Dawn's Appollo (4785)
A.I.S.	Glanavon Topsy 3rd	...	10-10-42	7-5-46	273	24	8,142	4-10	334-83	D. Bevan & Sons	Glanavon Federal (6869)
do.	Glanavon Melba 6th	...	12-12-42	12-7-46	273	12	7,806	4-19	327-15	D. Bevan & Sons	Glanavon Federal (6869)
Jersey	Radyr Park Dorothy 20th	...	17-6-42	12-5-46	273	15-5	6,451	4-89	315-54	L. M. Temple	Narva September Lad (14023)
A.I.S.	Wooroloo Bna	...	15-1-43	27-8-46	273	19	7,137	4-34	310-11	Wooroloo Sanatorium Farm	Berry Rufus 2nd (6579)
Jersey	Kapara Sparkles's Lassie 2nd	98818	14-10-42	30-4-46	273	8-5	6,775	4-53	300-97	D. Bradford	Congelin Tolly Eminent 3rd (18425)
do.	Kapara Dicks	...	14-9-42	10-5-46	273	10	5,445	5-38	304-14	D. Bradford	Congelin Mandarin (14542)
do.	Daungella Miss Muffet	92031	5-5-42	30-4-46	273	13	3,334	9-65	293-10	D. G. Spark	Pravagan Starburst King (18129)
Guernsey	Murek Dame Enid	...	17-5-42	20-1-46	273	9	6,057	4-82	292-51	College Agricultural College	Murek Arthur (4338)
A.I.S.	Southern Ada	...	17-5-42	10-5-46	273	10	7,665	8-78	289-94	W. K. Barnes	Yalliere Lancer (7592)
Jersey	Camden Biddy	...	1-7-42	11-2-46	273	16	7,958	5-26	282-23	Mrs. A. G. Ekersley	Grenmont Golden Bobbie (18578)
do.	Warralyn Marie 10th	89542	4-6-42	24-4-46	273	16-5	5,719	4-88	279-45	M. B. Stott	Juadine Sparkle's Wonder (18659)
do.	Juadine Lily	...	12-2-48	6-0-46	273	9	6,097	5-42	276-57	Mrs. A. G. Ekersley	Austral Park Wonderful Standard (12423)
A.I.S.	Glanavon Sylvia 3rd	...	12-10-42	17-4-46	273	12	6,306	4-33	273-54	D. Bevan & Sons	Blacklands Monarch's Commander (1877)
do.	Narragin Doreen	...	13-8-42	26-9-46	240	23	6,795	3-83	260-85	Narragin School of Agriculture	Tipperary Amy's Mascot (6338)
do.	Yokanup Ulery	...	18-10-42	12-7-46	273	13	6,879	3-07	252-93	Burkitt & Brown	Parkview Commodore (306)
do.	Lennox's Joan 3rd	...	20-7-46	23-7-46	240	17	6,360	3-92	249-20	G. W. Marston	Ferndale Memento (3194)
Guernsey	Brookfield's Clarette	10061	15-11-41	16-11-45	273	10	4,920	4-83	238-02	P. G. Hampshire & Son	Yaraview Clarinet (4928)
Jersey	Walget Handsome Girl 28th	...	21-5-42	21-5-46	273	10-5	4,861	4-84	235-80	C. J. Cunningham	Salsey Wyandotte's Prince (18058)
A.I.S.	Yokanup Carnation 4th	...	10-2-43	20-8-46	273	6	3,681	3-52	228-82	Burkitt & Brown	Parkview Commodore (306)
do.	Yokanup Dabla	...	6-8-46	6-8-46	273	3	5,634	3-86	217-71	Burkitt & Brown	Parkview Commodore (306)
do.	Tipperary Dove 21st	...	14-4-42	9-1-46	210	7	5,160	3-92	202-38	W. G. Burges	Tipperary Ace (6336)

TABLE 9—HERD TESTING—continued.

Name of Cow.	Breed.	Heal Book No.	Date Birth.	Date of Entry to Test.	No. of Days in Test.	Weight of Milk on Last Day of Test, lb.	Weight of Milk for Period, lb.	Average Test, %	Weight of Butter Fat for Period, lb.	Owner.	Sire.
COWS 3½ YEARS AND UNDER 4 YEARS—STANDARD 290 LB. BUTTER FAT—continued.											
Yokanup Gem 2nd	A.I.S.	...	23-1-43	15-10-46	180	15	5,280	3.30	179.49	Burkitt & Brown	Parkview Commodore (306)
Narragin Sally	do.	...	20-4-42	18-3-46	210	12	4,515	3.36	178.06	Narragin School	Tipperary Amy's Mascot (6338)
Kapara Dairymaid	Jersey	93308	24-6-42	15-5-46	120	18	2,820	5.21	147.03	D. Bradford	Concilio Mandarin (14542)
Narragin Dairyn	A.I.S.	...	2-5-42	26-3-46	90	22	2,400	4.00	101.94	Narragin School	Westly Masterpiece (3403)
Narragin Marion	do.	...	10-6-43	11-3-47	90	26	2,760	3.40	99.54	AgriCulture	Tipperary Amy's Mascot (6338)
Narragin Milly	do.	...	5-5-42	16-3-46	90	20	2,040	3.48	80.25	Narragin School	Tipperary Amy's Mascot (6338)
Narragin Dora	do.	...	1-7-43	11-3-47	90	18	1,470	4.02	59.22	Narragin School	Tipperary Amy's Mascot (6338)
Narragin Dinah	do.	...	21-7-42	12-3-46	60	18.5	1,395	3.64	50.82	Narragin School	Tipperary Amy's Mascot (6338)
COWS 4 YEARS AND UNDER 4½ YEARS—STANDARD 310 LB. BUTTER FAT.											
Grass Vale Northwood Eve	Jersey	92725	3-7-42	25-9-46	273	20	10,035	5.74	576.16	R. H. Rose & Sons	Mormoot Northwood Beau (17708)
Grass Vale Northwood 10th	do.	92724	27-6-42	9-8-46	273	18	7,074	5.40	414.42	R. H. Rose & Sons	Mormoot Northwood Beau (17708)
Grass Vale Northwood 10th	do.	95267	16-3-42	16-9-46	273	20	8,550	4.70	409.68	L. M. Temple	Navua Coronation Star (14920)
Grass Vale Northwood 4th	A.I.S.	86845	23-11-41	17-3-46	273	12	6,720	5.06	401.49	R. H. Rose & Sons	Mormoot Northwood Beau (17708)
Valliere Embrace	do.	...	14-4-42	12-9-46	273	28	10,173	3.92	399.43	B. W. Prowse	Wooroloo Searchlight (9415)
Capel Queen Regent	do.	...	2-5-42	20-8-46	240	13.5	8,520	4.22	359.97	B. W. Prowse	Capel Lottie's Reward (3782)
Tipperary Peggy 2nd	Jersey	40650	10-7-41	5-12-45	273	22	9,396	3.81	358.38	W. G. Burges	Tipperary Ace (6330)
Kapara Happy Days 2nd	do.	...	3-12-41	2-4-46	273	18	6,939	5.16	358.32	D. Bradford	Grandham Easter Oxford (14677)
Tirano Beauty	A.I.S.	...	11-9-41	5-2-46	273	31.5	9,109	3.88	356.42	J. Benstead	Chiffing Prince (3800)
Carbunup Esther	do.	...	18-2-42	16-4-46	273	11.5	7,549	4.33	327.21	D. H. Bell	Glauvion Maestro (4833)
Yokanup Pansy	do.	...	16-1-42	12-7-46	273	18	7,194	4.28	308.08	Burkitt & Brown	Parkview Commodore (306)
Tipperary Carnation 3rd	do.	...	8-1-42	6-6-46	273	12	6,429	4.76	306.12	Burkitt & Brown	Parkview Commodore (306)
Hades Toys Turvey	do.	40638	23-9-41	25-11-45	273	25	7,783	3.93	300.26	W. G. Burges	Tipperary Ace (6330)
Clovelly Primrose	do.	10245	30-6-42	30-8-46	273	18	7,404	4.02	300.26	W. G. Burges	Tipperary Ace (6330)
Clovelly Cherry	do.	10239	24-8-42	30-8-46	210	13	6,219	4.74	285.03	Mrs. L. R. Barnsby	Koojan Monogram (4174)
Glauvion Golden Girl 6th	A.I.S.	36555	17-9-41	7-2-46	273	9	3,790	5.40	252.70	Mrs. L. R. Barnsby	Koojan Monogram (4174)
Walgett Lady Wyandotte	Jersey	10280	29-4-42	27-6-46	240	5	8,807	4.30	252.70	C. J. Cunningham	Selsey Wyandotte's Prince (18058)
Denmark Dame 2nd	Guernsey	...	6-11-41	14-2-46	273	22.5	2,522	4.80	274.66	Denmark Research Station	Selsey Wyandotte's Prince (18058)
Walgett Joy's Gift	do.	...	6-4-42	28-5-46	273	9	6,222	4.35	271.06	C. J. Cunningham	Selsey Wyandotte's Prince (18058)
Walgett Handsome Girl 25th	do.	...	7-4-42	1-7-46	240	10	4,882	4.82	260.28	C. J. Cunningham	Selsey Wyandotte's Prince (18058)
Judine Peerless Lily 21st	do.	...	5-9-42	4-10-46	180	8.5	3,780	6.72	254.31	J. P. Smith	Austral Park Wonderful Standard (12423)
Clovelly Dainty	Guernsey	10241	5-8-41	2-1-46	273	5.5	5,026	5.04	253.54	Mrs. L. R. Barnsby	Koojan Monogram (4174)
Clovelly Roubette	do.	10238	12-7-41	9-10-45	273	12	4,746	5.25	249.33	Mrs. L. R. Barnsby	Koojan Monogram (4174)
Walgett Royal Lily	Jersey	...	26-3-42	23-5-46	240	10.5	5,175	4.78	247.59	C. J. Cunningham	Selsey Wyandotte's Prince (18058)

COWS 4½ YEARS AND UNDER 5 YEARS.—STANDARD 380 LB. BUTTERFAT.									
...
Lenmoor's Gentle	A.I.S.	10073	22-5-42	20-5-46	273	9	6,762	3-50	242-82
Brookfield's Pixie	Guernsey	...	15-5-41	9-11-43	250	11	5,265	4-30	336-35
Norinya Nita	Jersey	...	3-9-41	17-1-46	273	11	4,299	5-37	331-33
Lenmoor's Biddy	A.I.S.	...	22-2-42	17-4-46	273	12	6,463	3-36	323-69
Lenmoor's Queen 4th	do.	...	9-2-42	19-7-46	240	12	5,745	3-68	323-69
Pleahor Valley	do.	...	15-2-42	17-7-46	240	11	5,745	3-68	323-69
Clovelly Kitty	Guernsey	10243	20-6-42	9-7-46	240	11	4,350	4-82	209-10
Rosella Jeanette	do.	...	2-4-42	30-7-46	240	12-5	3,750	5-32	200-67
Pleahor Sapphire	A.I.S.	...	2-4-42	7-6-46	240	7-5	5,250	3-79	199-05
Pleahor Primrose	do.	...	26-6-42	16-9-46	273	3	5,734	3-34	193-73
Pleahor Curley	do.	...	26-6-42	23-10-46	273	3	5,430	3-36	182-91
Pleahor's Jean	do.	37899	26-6-42	10-10-46	180	13	4,815	3-56	171-87
Capel Gibson	do.	...	5-3-42	6-5-46	240	12-5	3,300	4-19	140-88
K. A. S. Bluebird	do.	10636	15-2-42	3-9-46	180	27	2,565	4-89	123-33
Rosella Girlie	do.	...	15-2-42	7-8-46	60	8	555	5-92	27-90
COWS 4½ YEARS AND UNDER 5 YEARS.—STANDARD 380 LB. BUTTERFAT.									
...
Grass Vale Buttercup 6th	Jersey	92713	24-5-41	7-5-46	273	24	9,832	6-02	593-91
Grass Vale Northwood	do.	86646	23-5-41	31-3-46	273	19	8,172	5-27	512-79
Grass Vale L. J. P. 83rd	do.	92716	7-5-41	5-0-46	273	21	9,168	6-55	509-23
Glanavon Maggie 2nd	A.I.S.	36563	21-2-41	14-11-45	273	32	11,571	4-31	499-72
Grass Vale Nora's Maid	Jersey	98527	9-9-41	5-6-46	273	19	9,507	5-04	479-33
Denmark Ace's Dawn	Guernsey	10281	16-6-41	3-6-46	273	23	8,529	5-43	463-43
Juandine Sally	Jersey	98755	5-10-41	19-5-46	273	23	8,769	5-00	498-78
Valliere Fairy 2nd	A.I.S.	40808	14-4-41	10-3-46	273	26	11,400	3-59	409-98
Tipperary Beauty 14th	do.	...	10-3-41	5-11-45	273	26	9,198	4-31	397-32
Waralyn Dianthus 3rd	Jersey	89538	24-7-41	3-7-46	273	20-5	7,051	5-10	390-47
Glanavon Fairy 6th	A.I.S.	36549	9-6-41	14-4-46	273	25	7,710	4-78	369-00
Wattle Creek Rosette	do.	40936	30-7-41	7-5-46	273	15	8,625	4-26	398-30
Clovelly Crystal	Guernsey	10240	31-8-41	25-6-46	273	8-5	7,255	4-87	354-69
Grass Vale Golden Cream 25th	Jersey	92713	4-5-41	4-4-46	273	12	6,007	6-07	351-62
Rady Park Dorothy 10th	do.	88043	7-5-41	10-4-46	273	12	6,666	5-24	349-39
Wattle Creek Bureup	A.I.S.	10866	15-4-41	30-7-46	273	17	7,701	4-44	345-95
Mayvale Golden Bellona	Guernsey	10866	15-5-41	16-12-45	273	16	5,628	5-88	331-43
Denmark Mary's Bonnie	do.	10295	22-7-41	9-2-46	273	19	5,832	5-23	395-47
Kapara Rosalind	Jersey	98310	8-6-41	3-5-46	273	10-5	5,536	5-36	396-88
Rady Park Dorothy 14th	do.	93266	22-4-41	6-9-46	273	17	6,246	4-61	287-96
Narrogin Dolly	A.I.S.	38669	20-8-41	27-3-46	240	22	6,615	4-16	275-22
Woorloo Ethel	do.	41179	2-4-41	10-1-46	273	10	6,150	4-34	267-52
Carbanup Dahlia	do.	35386	22-3-41	25-2-46	273	2-5	5,707	4-64	264-89
Woorloo Lady Fair 5th	do.	41193	9-5-41	19-2-46	273	9	5,157	4-57	235-73
Yanget Baron's Grace	do.	41223	3-9-41	2-6-46	273	5-5	6,131	3-57	218-58
Tipperary Dove 17th	do.	40637	26-3-41	6-12-45	273	6	5,448	3-81	207-65
Woorloo Daisybell 2nd	do.	41173	10-7-41	19-2-46	180	10	4,320	4-73	204-66
Narrogin Colleen	do.	38665	22-8-41	13-4-46	210	17	4,905	3-63	178-29
COWS 4½ YEARS AND UNDER 5 YEARS.—STANDARD 380 LB. BUTTERFAT.									
...
Woorloo Union Jack (7662)	G. W. Marston	...	...	...	...	...	6,762	3-50	242-82
Yanget Clarinet 2nd (4629)	P. G. Hampshire & Son	...	...	...	...	...	5,265	4-30	336-35
Norinya Nita (15899)	Mrs. A. G. Eversley	...	...	...	...	...	4,299	5-37	331-33
Ferrdale Radiant (57298)	G. W. Marston	...	...	...	...	...	6,463	3-36	323-69
Ferrdale Memento (3194)	G. W. Marston	...	...	...	...	...	5,745	3-68	323-69
Glanavon Genus (3957)	Mrs. V. Alexander	...	...	...	...	...	4,350	4-82	209-10
Landsdowne Polydrome (4995)	Mrs. L. R. Barnish	...	...	...	...	...	3,750	5-32	200-67
Muresk Commander (9599)	Darnell Brothers	...	...	...	...	...	5,250	3-79	199-05
Glanavon Genus (3957)	Mrs. V. Alexander	...	...	...	...	...	5,734	3-34	193-73
Glanavon Genus (3957)	Mrs. V. Alexander	...	...	...	...	...	5,430	3-36	182-91
Ferrdale Memento (3194)	G. W. Marston	...	...	...	...	...	4,815	3-56	171-87
Valliere Commodore (9360)	M. W. Provise	...	...	...	...	...	3,300	4-19	140-88
Honestead Ace (Imp.) (1631)	Darnell Brothers	...	...	...	...	...	2,565	4-89	123-33
Muresk Commander (4314)	Darnell Brothers	...	...	...	...	...	555	5-92	27-90
Grass Vale Gold Boy (14684)	R. H. Rose & Son	...	...	...	...	...	9,832	6-02	593-91
Mormoot Northwood Beau (17798)	R. H. Rose & Son	...	...	...	...	...	8,172	5-27	512-79
Mormoot Northwood Beau (17798)	R. H. Rose & Son	...	...	...	...	...	9,168	6-55	509-23
Blacklands Monarch's Commander (1877)	M. H. Montgomery	...	...	...	...	...	11,571	4-31	499-72
Mormoot Northwood Beau (17798)	R. H. Rose & Son	...	...	...	...	...	9,507	5-04	479-33
Honestead Ace (Imp.) (1631)	A. W. Padbury	...	...	...	...	...	8,529	5-43	463-43
Autral Park Wonderful Standard (12423)	M. B. Stott	...	...	...	...	...	8,769	5-00	498-78
Woorloo Searchlight (6415)	C. P. House	...	...	...	...	...	11,400	3-59	409-98
Tipperary Ace (6330)	W. G. Burges	...	...	...	...	...	9,198	4-31	397-32
Juandine Hall Boy (16615)	M. B. Stott	...	...	...	...	...	7,051	5-10	390-47
Blacklands Monarch's Commander (1877)	M. H. Montgomery	...	...	...	...	...	7,710	4-78	369-00
Woorloo Duchess' Monarch (5396)	E. T. Thatcher	...	...	...	...	...	8,625	4-26	398-30
Koan Monarch (4174)	Mrs. L. R. Barnish	...	...	...	...	...	7,255	4-87	354-69
Grass Vale Gold Boy (14684)	R. H. Rose & Son	...	...	...	...	...	6,007	6-07	351-62
Navia Coronation Star (14929)	L. M. Temple	...	...	...	...	...	6,666	5-24	349-39
Woorloo Royal Standard (6114)	E. T. Thatcher	...	...	...	...	...	7,701	4-44	345-95
Koan Ideal's Discoverer (4968)	R. J. Giles	...	...	...	...	...	5,628	5-88	331-43
Denmark Lady's Goldseeker (4799)	Denmark Research Station	...	...	...	...	...	5,832	5-23	395-47
Conzelin Mandarin (14542)	D. Bradford	...	...	...	...	...	5,536	5-36	396-88
Navia September Lad (14023)	L. M. Temple	...	...	...	...	...	6,246	4-61	287-96
Westby Masterpiece (5403)	Narrogin School of Agriculture	...	...	...	...	...	6,615	4-16	275-22
Woorloo Red Lad (5418)	Woorloo Sanatorium Farm	...	...	...	...	...	6,150	4-34	267-52
Glanavon Maestro (4893)	D. H. Bell	...	...	...	...	...	5,707	4-64	264-89
Woorloo Triumph's Heir (4493)	Woorloo Sanatorium Farm	...	...	...	...	...	5,157	4-57	235-73
Yanget Baron (6416)	Mrs. V. Alexander	...	...	...	...	...	6,131	3-57	218-58
Tipperary Ace (6330)	W. G. Burges	...	...	...	...	...	5,448	3-81	207-65
Woorloo Red Lad (5418)	Woorloo Sanatorium Farm	...	...	...	...	...	4,320	4-73	204-66
Westby Masterpiece (5403)	Narrogin School of Agriculture	...	...	...	...	...	4,905	3-63	178-29

TABLE 9—HERD TESTING—continued.

Name of Cow.	Breed.	Herd Book No.	Date of Birth.	Date of Entry to Test.	No. of Days in Test.	Weight of Milk on Last Day of Period. Lb.	Weight of Milk per Pound. Lb.	Average Test. %	Weight of Butter per Pound. Lb.	Owner.	Sire.
COWS 4½ YEARS AND UNDER 5 YEARS.—STANDARD 330 Lb. BUTTERFAT											
Carydale Victoria Floss	A.I.S.	93396	15-7-41	16-4-46	180	17	4.855	3.76	168.66	W. K. Barnes	Summerlea Robin Hood (5261)
Muresk Danzie	Guernsey	11062	15-1-41	12-0-46	120	22	3.090	4.47	138.39	Muresk Agricultural College	Muresk Arthur (4338)
Narrogin Sally	A.I.S.	...	26-4-42	6-2-47	90	10	1.290	3.84	49.59	Narrogin School of Agriculture	Tipperary Amy's Mascot (6338)
Brookfields Morden Lady 5th	Guernsey	10071	20-10-41	27-5-46	30	24.5	7.35	5.38	39.60	P. G. Hampshire & Son	Yarraview Clarinet 2nd (4626)
COWS 5 YEARS AND OVER.—STANDARD 350 Lb. BUTTERFAT.											
Glanavon Rosina	A.I.S.	30693	2-5-37	5-9-46	273	21	13.410	4.32	647.54	D. Bevan & Sons	Blacklands Jean's Supreme (1871)
Kooljan Golden Jewel	Guernsey	8909	12-3-40	21-12-45	273	20	9.963	5.38	556.34	A. W. Padbury	Kooljan Beau Ideal (4965)
Congelin Iolanthe 8th	Jersey	80828	22-4-40	21-6-46	273	28.5	10.810	4.93	533.96	D. Bradford	Rosecliffe Marchalng (19094)
Valliere Fairy 3rd	A.I.S.	40883	17-5-40	9-5-46	273	27	14.661	3.69	527.35	B. W. Prowse	Summerlea Pioneer (6240)
Wooroloo Poppy 2nd	do.	28263	4-5-35	20-3-46	273	34	11.577	4.48	519.65	Wooroloo Sanatorium Farm	Parkview Guardian (2557)
Congelin Rose Marie 6th	Jersey	80830	14-4-40	10-4-46	273	24	8.067	6.38	514.89	D. Bradford	Rosecliffe Marchalng (15094)
Grass Vale Buttercup 7th	do.	81022	9-9-39	20-8-46	273	23	9.264	5.10	473.33	R. H. Rose & Son	Grass Vale Gold Boy (14684)
Wooroloo Lilac 2nd	A.I.S.	33993	18-12-39	22-7-46	273	20	10.440	4.43	463.00	Wooroloo Sanatorium Farm	Wooroloo Triumph's Heir (4493)
Carbunup Beatrice	do.	20617	13-3-39	13-3-46	273	26	10.788	4.28	462.12	D. H. Bell	Glanavon Maestro (4833)
Tipperary Beauty 9th	do.	40631	21-2-40	19-4-46	273	23	10.809	4.26	461.40	W. G. Burges	Blacklands Monarch's Commander (1877)
Tipperary Beauty 11th	do.	40633	20-9-40	9-3-46	273	29	10.257	4.40	461.02	M. H. Montaguery	Liberal Tourist (3419)
Tipperary Beauty 6th	do.	25217	8-8-38	2-5-46	273	18	10.344	4.76	455.14	W. G. Burges	Newstead Tourist (3419)
Congelin Iolanthe 10th	Jersey	91295	25-3-41	15-4-46	273	26	9.438	4.76	445.45	D. Bradford	Congelin Washington (14826)
Denmark Briar Rose	Guernsey	6959	16-8-37	31-8-46	273	17	8.616	5.02	432.57	Denmark Research Station	Denmark Illustrious (3320)
Tipperary Lovely 5th	A.I.S.	40645	10-6-41	5-7-46	273	18	10.074	4.25	428.39	W. G. Burges	Tipperary Ace (6330)
Radyr Park Dorothy 4th	Jersey	65850	3-10-35	27-5-46	273	20	8.355	5.00	417.80	L. M. Temple	Greenmount Graceful Lad (7202)
Charmont Pinafore 12th	A.I.S.	35549	25-7-46	2-10-46	273	32	10.806	3.82	413.86	Charmont Hospital for Insane	Westbay Monarch (5404)
Carbunup Baroness	do.	20616	15-4-39	30-5-46	210	17.5	9.855	4.16	410.73	D. H. Bell	Glanavon Maestro (4833)
Valliere Melba	do.	33717	8-9-39	7-2-46	273	19	11.085	3.68	408.90	C. P. House	Alfa Vale Patrio (3649)
Tyrano Park Dorothy 10th	do.	33580	15-10-38	14-6-46	273	19	8.577	4.75	407.58	M. H. Montaguery	Inverell Gold's Pride (4076)
Radyr Park Dorothy 10th	Jersey	83556	4-7-39	31-8-46	240	15	8.970	4.53	406.80	L. M. Temple	Navua Coronation Star (14929)
Inverell Gold Lady	A.I.S.	37427	9-10-38	26-8-46	273	17	9.711	4.41	399.35	W. G. Burges	Blacklands Monarch's Commander (1877)
Wooroloo Wendy 4th	do.	34005	14-9-39	13-10-45	273	20	8.650	4.57	396.08	Wooroloo Sanatorium Farm	Parkview Guardian (2557)
Valliere Judy	do.	40810	15-4-41	3-5-46	273	8	10.479	3.77	395.22	C. P. House	Wooroloo Seardlight (6415)
Muresk Lady Bouface	Guernsey	11067	29-4-41	24-5-46	273	16	6.558	5.89	386.68	Muresk Agricultural College	Denmark Damon (2519)
Congelin Sparkle 4th	Jersey	91297	15-3-41	13-5-46	273	20	8.850	4.36	386.18	D. Bradford	Congelin Washington (18426)
Valliere Star	A.I.S.	33720	28-3-39	15-3-46	273	15	9.735	3.80	375.95	C. P. House	Alfa Vale Patrio (3649)

Clovelly Golden Pride Woorooloo Pigeon	Guernsey A.I.S.	8501 41198	26-10-38 20-0-40	25-0-46 3-7-46	273 273	8	7,584 8,682	4-04 4-30	374-84 375-06	Mrs. L. R. Barnshy Woorooloo Sanatorium Farm	Drakesbrook Golden Gilt (26511) Woorooloo Triumph's Hair (4403)
Denmark Golden Valencia 2nd	Guernsey	8525	15-9-39	17-3-46	273	25	7,830	4-75	372-22	Denmark Research Station	Kooljan Ace's Goldseeker (3431)
Denmark Rosemary	do.	5451	7-6-36	28-1-46	273	14	6,852	5-40	370-59	Denmark Research Station	Kooljan Golden Prosper (2283)
Woorooloo Faith	A.I.S.	33089	10-1-39	7-1-46	273	16	8,568	4-30	368-81	Woorooloo Sanatorium Farm	Glanavon Geffins (3957)
Radyr Park Coronation's Es- trella	Jersey	83555	27-7-39	2-6-46	273	19	7,272	5-06	368-14	L. M. Temple	Naxna Coronation Star (1492)
Valencia Vale Chloe	do.	...	8-6-40	29-7-46	273	13	5,799	6-34	368-05	K. V. Gray	Grass Vale Fowler's Twyllish (12733)
Denmark Golden Glory	Guernsey	0965	13-5-38	29-7-46	273	19	7,317	4-98	364-73	Denmark Research Station	Denmark Damon (2519)
Melrose Butterscotch	A.I.S.	38269	5-3-40	17-10-45	273	15-5	8,716	4-15	362-56	M. H. Montzomery	Tipperary Bellance (5329)
Warralyn Marie 5th	Jersey	84475	14-8-39	6-3-46	273	16	6,513	5-30	359-22	M. B. Stoff	Juadine Hall Boy (16615)
Canden Celia	do.	86037	24-9-39	23-7-46	273	11	6,093	5-77	352-09	C. E. Krueger	Greenmount Golden Sultan (14088)
Muresk Della	Guernsey	9105	11-5-39	28-4-46	273	19	8,217	4-27	351-69	Muresk Agricultural College	Denmark Damon (2519)
Denmark Golden Dawn	do.	4118	9-1-33	30-10-45	273	14	6,117	5-67	346-89	Denmark Research Station	Kooljan Golden Prosper (2288)
Radyr Park Dorothy 5th	Jersey	08752	18-7-36	5-7-46	273	11	6,363	5-40	345-53	L. M. Temple	Greenmount Graceful Lad (7292)
Bungella Dark Venus	do.	92630	18-5-37	15-6-46	273	3	7,259	5-77	343-31	D. G. Spark	Travalgan Starbright King (18126)
Greenmount Golden Gem	do.	70019	3-7-37	11-6-46	273	9	6,352	5-24	343-75	D. G. Spark	Bonacure Bonaparte's Bonedienne (9224)
Clovelly Golden Flirt	Guernsey	8500	1-6-39	25-7-46	273	8	6,504	5-23	340-53	Mrs. L. R. Barnshy	Kooljan Monogram (4174)
Clovelly Rose	do.	6931	1-10-38	6-6-46	273	10	6,525	5-20	339-21	Mrs. L. R. Barnshy	Muresk Achilles (1543)
Melbury Janet	A.I.S.	26505	18-7-37	30-3-46	273	16	8,163	4-15	339-18	G. W. Marston	Telyarup Roosevelt (1538)
Valliere Buttercup	do.	40796	9-5-40	25-3-46	273	12	8,796	3-84	338-42	C. P. House	Alfa Vale Patrio (3649)
Norliva Noreen	Jersey	73200	6-11-37	23-8-46	273	11	7,338	4-61	338-37	Mrs. A. G. Eckersley	Juadine Prince (14760)
Valliere Primrose	A.I.S.	10950	19-5-40	13-5-46	240	23	7,980	4-21	335-96	W. K. Barnes	Alfa Vale Patrio (3649)
Mayvale Rosy Aster	Guernsey	10870	27-9-40	17-6-46	273	17	6,231	5-38	335-66	R. J. Giles	Denmark Rosy Outlook (3649)
Brookfields Lady Lynette	do.	5327	21-7-34	17-6-46	273	13-5	7,375	4-54	335-47	Darnell Brothers	Kooljan Lord Barklay (1031)
Valliere Kate	A.I.S.	40817	28-6-40	10-3-46	273	16	6,118	3-47	334-70	C. P. House	Alfa Vale Patrio (3649)
Woorooloo Poppy 4th	do.	28654	12-4-38	6-3-46	273	15	7,560	4-60	332-92	Woorooloo Sanatorium Farm	Parkview Guardian (2557)
Clarendon Cherry 9th	do.	15955	25-11-34	27-5-46	273	19	8,412	3-93	330-91	Narrogin School of Agriculture	Tipperary Virginia's Re-echo (970)
Noorong Dahlia	Jersey	...	26-12-39	17-8-46	273	8	6,654	4-96	330-42	K. V. Gray	Clarendon Eyre Embinent's Geishar 4th (18397)
Clovelly Bella	Guernsey	8496	20-10-39	1-5-46	273	16	6,993	5-15	329-40	Mrs. L. R. Barnshy	Kooljan Monogram (4174)
Clenden Patsy	Jersey	83543	27-6-39	2-1-46	273	14	5,352	6-12	327-86	C. E. Krueger	Greenmount Golden Sultan (14088)
Glanavon Daphne 3rd	A.I.S.	23165	18-2-37	21-9-46	273	12	9,246	3-52	325-63	Burkitt & Brown	Parkview Commodore (306)
Bungella Coquette	Jersey	81271	24-5-40	0-5-46	273	15	6,253	5-20	325-39	D. G. Spark	Greenmount Golden Sovereign (14687)
Glanavon Bluebell	A.I.S.	25157	1-3-36	31-5-46	240	20	7,560	4-24	320-58	G. W. Marston	Clarendon Xmas (427)
Clovelly Margaret	Guernsey	6929	20-11-37	20-6-46	273	4	6,312	5-03	317-26	Mrs. L. R. Barnshy	Norliva Bank Brian (3640)
Carbanup Crocus	A.I.S.	35385	25-2-40	13-3-46	273	3	7,809	4-03	315-15	D. H. Bell	Glanavon Maestro (4833)
Rutherford Rosebud	Guernsey	7827	15-7-37	12-3-46	273	18	6,459	4-80	310-63	Misses E. & I. Rutherford	Denmark Robin Hood (3922)
Clovelly Bobette	do.	10238	12-7-41	5-10-46	240	11-5	5,775	5-37	310-11	Mrs. L. R. Barnshy	Kooljan Monogram (4174)
Muresk Treasure	do.	9118	12-7-39	22-6-46	240	12	6,450	4-79	309-06	Muresk Agricultural College	Muresk Homestead (2075)

TABLE 9.—HERD TESTING—continued.

Name of Cow.	Breed.	Herd Book No.	Date of Birth.	Date of Entry to Test.	No. of Days in Test.	Weight of Milk on Last Day of Test, lb.	Weight of Milk for Period, lb.	Average Test, %	Weight of Butter Fat for Period, lb.	Owner.	Sire.
Rad'yr Park June 2nd	Jersey	88045	10-5-41	8-8-46	273	11	6,093	4.67	308.91	L. M. Temple	Navia Coronation Star (14929)
Eungella Bo-peep	do.	71246	27-12-37	26-4-46	273	16	7,199	4.28	308.41	L. M. Temple	Greenmount Golden Sovereign (14687)
Salem View Torsey 2nd	A.I.S.	13940	9-1-33	24-11-45	273	35	8,835	3.47	307.29	Mrs. E. L. Brockman	Kinsman of Greyleigh (111)
Clovelly Golden Dawn	Guernsey	8409	15-10-39	17-5-46	273	9.5	5,863	5.22	306.36	Mrs. L. R. Barnaby	Koojan Monogram (4174) (1929)
Rad'yr Park Coronation Belle	Jersey	72600	5-7-38	11-7-46	240	13	6,890	4.74	302.94	L. M. Temple	Navia Coronation Star (4174) (1929)
Denmark Atalie	Guernsey	5436	23-6-34	5-4-46	273	20	6,795	4.49	302.31	Misses E. & I. Ruthersford	Koojan Golden Prosper (2253)
Carbunup Constance	A.I.S.	35384	26-2-40	27-3-46	273	2	7,341	4.10	301.30	D. H. Bell	Glanavon Maestro (4823)
Walgett Easter Lily	Jersey	69579	20-4-37	15-4-46	273	15	6,870	4.54	292.21	C. H. Cunningham	Walgett Bean's Masterpiece (13849)
Glanavon Aster	A.I.S.	30575	18-1-38	21-4-46	273	10	7,140	3.76	292.15	D. H. Bell	Glanavon Maestro (4837)
Carbunup Doris	do.	35389	3-8-41	14-8-46	273	13	7,465	3.76	294.78	D. H. Bell	Glanavon Maestro (4833)
Glanavon Vida 4th	do.	36501	16-6-40	17-6-46	273	18	6,965	3.40	294.42	Burkitt & Brown	Tipperary President (5395)
Westlawn Daisy	do.	40989	8-6-40	10-5-46	273	9.5	6,975	4.22	294.42	Mrs. E. L. Brockman	Claremont Mount Rufus (3803)
Clovelly Wavelet	Guernsey	10247	28-7-41	31-7-46	273	2	6,800	4.45	294.28	Mrs. L. R. Barnaby	Koojan Monogram (4174)
Lennoor's Queen 2nd	do.	37904	24-7-37	25-2-46	273	18.5	8,200	3.57	292.87	G. W. Marston	Lennoor's (4977)
Glanavon Pansy 4th	A.I.S.	36508	19-11-37	13-9-46	240	7	8,750	4.31	290.06	Burkitt & Brown	Blacklands Jean's Supreme (1871)
Denmark Golden Maria	Guernsey	5329	27-6-40	6-6-46	273	12	5,181	5.59	289.85	Denmark Research Station	Denmark Danmaric (4000)
Walgett Joyful	Jersey	70450	29-8-38	24-4-46	273	12	5,601	5.08	284.81	C. J. Cunningham	Sabha Vale Betty's Beau (10018)
Brookfield's Mignonette	Guernsey	5329	18-6-35	11-4-46	273	14	6,087	4.67	284.86	Darnell Brothers	Koojan Lord Barclay (1031)
Leuro's Joan	A.I.S.	31611	13-8-39	27-2-46	273	16.5	8,014	8.52	283.63	G. W. Marston	Longridge Blanche's Emblem (3344)
Denmark Dawn 2nd	Guernsey	5430	21-3-35	23-2-46	273	16	5,308	5.12	283.47	Denmark Research Station	Koojan Golden Prosper (2258)
Walgett Jocelyn	Jersey	89500	13-8-40	24-3-46	273	21	5,718	4.91	280.95	C. J. Cunningham	Selsey Wyandotte's Prince (18058)
Connelly Tointhe 11th	do.	91296	21-8-41	29-6-46	273	5.5	5,868	4.95	280.46	D. Bradford	Congelin Washington (18426)
Koojan Ideal's Judith	Guernsey	10696	24-6-40	25-12-45	180	17	5,040	5.51	278.07	A. W. Padbury	Glenburne Ideal (2548)
Valliere Milkmaid	A.I.S.	40824	15-4-40	27-3-46	273	7	7,011	5.07	277.09	W. K. Barnes	Alfa Vale Pacesetter (3646)
Walgett Heirloom	Jersey	89499	20-4-40	22-3-46	273	9	5,367	5.15	270.76	C. J. Cunningham	Sabha Vale Betty's Beau (10018)
Denmark Diana	Guernsey	6963	28-6-36	22-11-45	273	17	6,066	4.60	270.35	Denmark Research Station	Denmark Danon (2519)
Westby Carnation 5th	A.I.S.	40984	25-6-39	28-8-46	273	7	7,881	9.50	275.94	Burkitt & Brown	Westby Star (3406)
Claremont Flora	do.	15961	27-8-34	10-6-46	273	21	8,308	8.24	275.93	Narragin School of Agriculture	Claremont Herdsman (908)
Rutherford Maid Marlon	Guernsey	9328	11-1-39	3-6-46	273	14	6,417	4.29	275.45	Misses E. & I. Ruthersford	Denmark Robin Hood (3322)
Narragin Charlotte	A.I.S.	38063	13-4-40	22-5-46	273	23	8,049	3.35	270.21	Narragin School of Agriculture	Westby Masterpiece (3403)
Juadine Peerless Lily 17th	Jersey	81991	18-12-39	31-5-41	240	11	4,380	6.13	268.80	Mrs. A. G. Eckersley	Austral Park Wonderful Standard (12423)
Koojan Golden Ripple	Guernsey	7248	26-3-38	27-6-46	273	14	5,607	4.74	265.85	Denmark Research Station	Homestead Ace (Imp.) (1031)

COWS 5 YEARS AND OVER.—STANDARD 350 LB. BUTTERFAT—continued.

Narrogin Donna	...	A.I.S.	32144	27-10-39	8-7-46	273	9	7,407	3-57	204-51	Narrogin School of Agriculture	Wooroboo Sterling 3rd (3020)
Mokine Amy 7th	...	Jersey	87016	1-8-39	25-4-43	240	13	5,100	5-07	203-46	K. V. Gray	Selsay Hall Boy (15136)
Walgett Handsome Girl 16th	...	do.	84483	20-5-39	31-5-46	240	13	5,285	4-71	203-22	C. J. Cunningham	Walgett Masterman (15271)
Walgett Handsome Girl 5th	...	do.	84483	17-5-39	12-7-46	240	13	5,285	4-71	203-22	C. J. Cunningham	Sabina Vale Betty's Bean (10018)
Walgett Handsome Girl 13th	...	do.	84483	2-5-39	12-7-46	273	13	5,285	4-71	203-22	C. J. Cunningham	Sabina Vale Betty's Bean (10018)
Narrogin Daisywell	...	A.I.S.	38668	10-10-40	6-3-46	273	2-5	5,632	4-34	257-65	Narrogin School of Agriculture	Westly Masterpiece (5439)
Rutherford Robin's Daisy	...	Guernsey	9329	11-9-38	1-4-46	273	14-5	5,143	4-99	257-07	Misses E. & I. Rutherford	Denmark Robin Hood (3322)
Walgett Handsome Girl 4th	...	Jersey	59001	5-4-35	6-5-46	240	11	5,130	4-97	255-05	C. J. Cunningham	Sabina Vale Betty's Bean (10018)
Denmark Bonnie Mary	...	Guernsey	6038	30-0-37	23-4-46	273	16	6,033	4-20	255-01	Denmark Research Station	Denmark Illerrius (3320)
Walgett Handsome Girl 12th	...	Jersey	79447	24-4-38	27-5-46	240	13	6,480	4-03	251-28	C. J. Cunningham	Sabina Vale Betty's Bean (10118)
Walgett Handsome Girl 10th	...	do.	84440	6-4-39	17-5-46	240	9	4,665	5-35	249-72	C. J. Cunningham	Sabina Vale Betty's Bean (10018)
Walgett Handsome Girl 9th	...	do.	89578	16-5-37	12-7-46	210	8	5,340	4-04	247-98	C. J. Cunningham	Sabina Vale Betty's Bean (10018)
Covelly Daisy	...	Guernsey	10241	5-8-41	10-10-46	240	9	5,670	4-35	247-20	Mrs. L. R. Barnishy	Ko Jan Manran (4174)
Eugenia Bonetta	...	Jersey	92029	17-5-41	11-8-46	210	2-5	4,755	5-18	246-33	D. G. Spark	Tavalgan Starbright King (18120)
Denmark Rosette	...	Guernsey	6972	21-7-36	30-5-46	273	8	5,634	4-69	235-92	Denmark Research Station	Ko Jan Golden Prosper (2283)
Camden Arachne	...	Jersey	80635	9-9-39	27-9-46	273	8	4,449	5-28	234-94	C. E. Kruger	Greenmount Golden Sultan (14688)
Westly Laurel	...	A.I.S.	40986	7-2-40	26-4-46	273	17	5,856	4-01	234-12	Narrogin School of Agriculture	Westly Searchlight (3604)
Rosella Zinnia	...	Guernsey	11430	11-8-40	3-5-46	273	6	4,473	5-17	231-24	Darnell Brothers	Muresk Paul (4336)
Denmark Velvet	...	do.	8540	23-8-38	24-11-45	240	14	5,220	4-42	230-94	Denmark Research Station	Denmark Amie (3313)
Rutherford Rosalyn	...	do.	6204	18-8-35	11-9-46	273	11-5	4,879	4-70	229-60	Misses E. & I. Rutherford	Denmark Rosa's Prosper (2639)
Planarhor Tulip	...	A.I.S.	89216	4-4-40	26-6-46	240	7-5	6,645	3-45	229-08	Mrs. V. Alexander	Alne Bank Tona's Gift (1760)
Walgett Golden Duchess	...	Jersey	79446	21-5-38	5-4-36	273	8-5	5,110	4-45	227-74	C. E. Kruger	Sabina Vale Betty's Bean (10018)
Denmark Dawn Childie	...	Guernsey	6962	14-5-37	24-12-45	240	10	4,575	4-71	225-81	Denmark Research Station	Woolongbar Reformer (538)
Denmark Angelina	...	do.	6956	4-7-37	20-10-45	273	12-5	4,792	4-70	225-62	Denmark Research Station	Ko Jan Golden Prosper (2283)
Walgett Handsome Girl 20th	...	Jersey	84441	21-4-39	10-7-46	180	13-5	4,275	5-14	220-11	C. J. Cunningham	Sabina Vale Betty's Bean (10018)
Walgett Melanie	...	do.	9107	10-4-41	17-7-46	180	11-5	4,360	4-72	216-75	C. J. Cunningham	Selsay Wyandotte's Prince (18058)
Muresk Golden Pearl	...	Guernsey	9107	9-10-39	10-11-45	240	15	4,140	5-14	213-18	Muresk Agricultural College	Muresk Homestead (2075)
Narrogin Stella	...	A.I.S.	38676	19-4-40	21-4-46	210	11	5,175	4-10	212-58	Narrogin School of Agriculture	Westly Masterpiece (5403)
Claremont Duchess 2nd	...	do.	9920	17-10-33	12-4-46	240	8-5	7,110	2-81	200-25	Narrogin School of Agriculture	Tipperary Virginia's Re-echo (970)
Yanget Graceful 4th	...	do.	78124	9-10-39	23-7-46	273	5-5	5,747	3-47	199-37	Mrs. V. Alexander	Leylands Defiance (2380)
Noorong Grace	...	Jersey	10081	3-10-33	21-3-46	240	6	4,005	4-71	188-97	C. E. Kruger	Grass Vale Butter King (8209)
Brookfields Sonata	...	Guernsey	33588	1-10-40	9-3-46	240	12	3,510	5-13	180-24	P. G. Hampshire & Son	Yarraview Clarinet 2nd (4629)
Carbunup Dora	...	A.I.S.	33588	1-4-41	29-4-46	120	33	4,735	3-73	177-39	D. H. Bell	Glanvyn Maestro (4533)
Narrogin Minnie	...	do.	38671	25-11-39	4-3-46	120	20	4,215	4-20	177-30	Narrogin School of Agriculture	Wooroboo Sterling 3rd (3020)
Rosella Queenie	...	Guernsey	9316	20-9-39	19-7-46	210	9	3,750	4-62	173-40	Denmark Brothers	Muresk Paul (4356)
Inverell Gold Lady	...	A.I.S.	37427	9-10-38	19-12-45	210	9	4,360	3-79	172-86	W. G. Burgess	Blacklands Murek's Commander (1877)
Planarhor Dandelion	...	do.	39210	30-12-39	28-2-46	210	14	4,425	3-80	168-57	Mrs. V. Alexander	Tipperary Empress' Monarch (4436)
Yanget Daphne 5th	...	do.	34021	15-9-38	19-2-46	240	10-5	3,770	3-70	163-66	Mrs. V. Alexander	Blacklands Lancer (1574)
Rosella Sweetheart	...	Guernsey	11429	30-7-40	11-10-46	120	16	3,000	5-01	150-30	Darnell Brothers	Muresk Paul (4356)
Brookfields Prudence	...	do.	8389	12-1-40	4-12-45	273	5	2,630	5-68	149-39	P. G. Hampshire & Son	Yarraview Clarinet (4628)
Mokine Empire's Girl	...	Jersey	82897	29-7-39	6-9-46	120	19	3,120	4-73	147-81	K. V. Gray	Selsay Hall Boy (15136)

TABLE 9—HERD TESTING—*continued*.

Name of Cow.	Breed.	Herd Book No.	Date of Birth.	Date of Entry to Test.	No. of Days in Test.	Weight of Milk on Last Day of Test, lb.	Weight of Milk for Fat Test, lb.	Average Test, %	Weight of Butter for Fat Test, lb.	Owner.	Sire.
COWS 5 YEARS AND OVER—STANDARD 350 Lb. BUTTER FAT.— <i>continued</i> .											
Denmark Golden Dawn 2nd	Guernsey	8527	2-4-40	1-11-46	210	5.5	2,040	5.57	147.15	Denmark Research Station	Koojan Ace's Goldseeker (3431)
Brookfields Bonnie Blossom	do.	5319	15-8-34	9-10-46	120	19.5	3,300	4.44	146.70	Darnell Brothers	Koojan Lord Barklay (1031)
Narrogin Clara	A.I.S.	38664	19-3-40	10-3-46	240	9	3,765	3.70	139.50	Narrogin School of Agriculture	Westby Masterpiece (5408)
Koojan Ace's Dulcie	Guernsey	5658	6-3-36	13-4-46	90	27	2,790	4.88	136.41	Denmark Research Station	Homeslead Ace (Imp.) (1631)
Vinewood Sweet Ginger	Jersey	59890	8-10-34	24-12-46	90	20.5	2,340	5.23	122.43	J. P. Smith	Moorlands Duke (11908)
Grass Vale Silvermine	do.	81639	6-11-40	14-4-46	60	39	2,220	5.32	118.26	R. H. Rose & Son	Grass Vale Gold Boy (14084)
Clovelly Dutchesse	Guernsey	8497	8-7-38	19-4-46	120	17	2,370	4.79	113.64	Darnell Brothers	Marek Nelson (3020)
Brookfield's Hope	do.	5325	14-6-34	15-10-46	120	14.5	2,595	4.24	110.25	Darnell Brothers	Koojan Lord Barklay (1031)
Connelly Happy Days 3rd	Jersey	85704	1-2-41	19-5-46	100	22	2,190	4.66	102.21	D. Bradford	Connelly Washington (18320)
Plenarbor Dandelion	A.I.S.	39210	30-12-39	13-12-46	150	10	3,120	3.20	98.90	Mrs. W. Alexander	Tipperary Empress Monarch (4386)
Brookfields Primrose	Guernsey	5331	24-2-33	8-9-46	130	10	2,055	4.54	92.30	Darnell Brothers	Koojan Ace's Gold Boy (14084)
Rosella Queen	do.	9315	3-7-39	20-6-46	100	14	2,075	4.54	92.30	Darnell Brothers	Marek Paul (4356)
Denmark Jonquil	do.	8586	24-4-40	30-5-46	120	16	1,865	4.43	87.06	Denmark Research Station	Koojan Bean Ideal (4965)
Rosella Duchess 2nd	do.	9310	7-5-39	6-7-46	120	13	1,605	4.32	71.97	Darnell Brothers	Marek Paul (4356)
Grass Vale Twylish Lady	Jersey	76604	14-10-38	8-8-46	30	42	1,200	4.74	59.76	R. H. Rose & Son	Grass Vale Gold Boy (14084)
Narrogin Maie	A.I.S.	32196	1-11-38	4-4-46	60	28	1,680	3.42	57.60	Narrogin School of Agriculture	Woorloo Sterling 3rd (3026)
Denmark Mary Rose	Guernsey	6066	7-7-38	24-2-47	30	36	1,080	5.30	57.24	Denmark Research Station	Denmark Auric (3313)
Clovelly Tigress	do.	10246	11-7-40	20-5-46	60	17	1,140	4.45	50.79	Mrs. L. R. Barnsby	Koojan Monogram (4174)
Narrogin Daisy	A.I.S.	38667	20-11-39	8-4-46	60	20	1,290	3.05	39.45	Narrogin School of Agriculture	Woorloo Sterling 3rd (3026)
Glanvon Vida 3rd	do.	30609	19-5-39	29-7-46	60	25	1,500	2.42	36.30	Buckitt & Brown	Parkview Commodore (306)
Westby Polly	do.	15141	21-5-32	21-5-46	30	35	1,050	2.92	30.66	Narrogin School of Agriculture	Telyarup Duke (956)
Rosella Lady Luck	Guernsey	9313	28-7-38	2-10-46	30	19	570	4.59	26.19	Darnell Brothers	Brookfields Baron (3936)
Clovelly Queen	do.	6934	1-7-36	9-7-46	30	21	630	4.63	25.41	Mrs. J. R. Barnsby	Koojan Sir Garnet (847)

NEW CEREAL VARIETIES IN WESTERN AUSTRALIA.

By

I. THOMAS, REGISTRAR OF CEREAL VARIETIES IN AUSTRALIA.

During 1947 one new wheat variety and one oat variety were submitted for registration by the Victorian Department of Agriculture. Particulars of the varieties are as follows :—

Diadem.—A wheat variety of midseason to late maturity, originating from a cross between Ghurka and White Fife made at the State Research Farm, Werribee, Victoria, in 1932 by Mr. A. R. Raw. Subsequent selection was carried out at the Longerenong Agricultural College, Victoria. The straw is white and short, although a little longer than the parent Ghurka, with good standing ability. It has a compact square head which threshes readily. The grain is attractively bright coloured and is semi-translucent ; flour strength is in the medium strong class, being markedly superior to Ghurka and Quadrat, which varieties the Victorian Department of Agriculture recommends it to replace.

Diadem possesses a moderate resistance to flag smut, but is susceptible to rust. Its main outstanding ability is its prolificacy. In replicated yield trials extending over six years at Longerenong College, Diadem, as selection L5266/T39-1-1 of the cross (Ghurka x White Fife), was the leading variety, having an average yield of 29.1 bushels per acre as compared with Quadrat 27.7, Magnet 27.2 and Ghurka 25.9. The Victorian Department of Agriculture recommends this variety as being more suitable for the "Wimmera Plains" than for the drier or earlier districts.

Orient.—An oat variety of parentage Palestine x Dawn, crossed at the State Research Farm, Werribee, by Mr. A. R. Raw in 1930. Subsequent selection was carried out at the Mallee Research Station, Walpeup. It is an early maturing variety possessing short, fairly strong straw, good stooling ability, prostrate early growth and a relatively long rosette stage with a short post jointing stage. Grain is large and plump with a dark coloured husk and the yield ratio of grain to hay is high.

Orient is not recommended as a hay variety for sowing on non-fallowed land, and has been selected mainly as a grazing oat which, in late season grazing, returns higher yields of greenstuff than Dawn or Algeribee. Under conditions at Walpeup, where the variety was tested for eleven years, it was found that Orient could be grazed later in the season than other early maturing oats, while still retaining the ability of giving a reasonable grain return.

ERRATA.

Vol. XXIV., No. 3.—September, 1947.

Page 219.—AGRICULTURAL PROBLEMS—

For

“Bridgetown . . . K. M. Simes (Dairying): A. Flintoff (Fruit)”

substitute

“Bridgetown . . . K. M. Simes (Dairying): T. Herlihy (Fruit).”

Pages 222-225.—Repeat 300,000 ; 200,000 ; 100,000 for each factory.

Page 226.—Last paragraph, line five—

For

“to 6.9, pH 7.0 to 7.2, and values greater than 7.2 pH”

substitute

“to 6.9, pH 7.0 to 7.2, and values greater than pH 7.2.”

Page 228.—AUTHOR—

For“C. A. Gardiner, Government Botanist” *substitute*

“C. A. Gardner, Government Botanist.”

Page 247.—Line one of note at foot of page—

For “three shillings” *substitute* “six shillings.”

POULTRY FEEDING EXPERIMENTS No. 3.

By R. H. MORRIS, Agricultural Adviser.

INTRODUCTION.

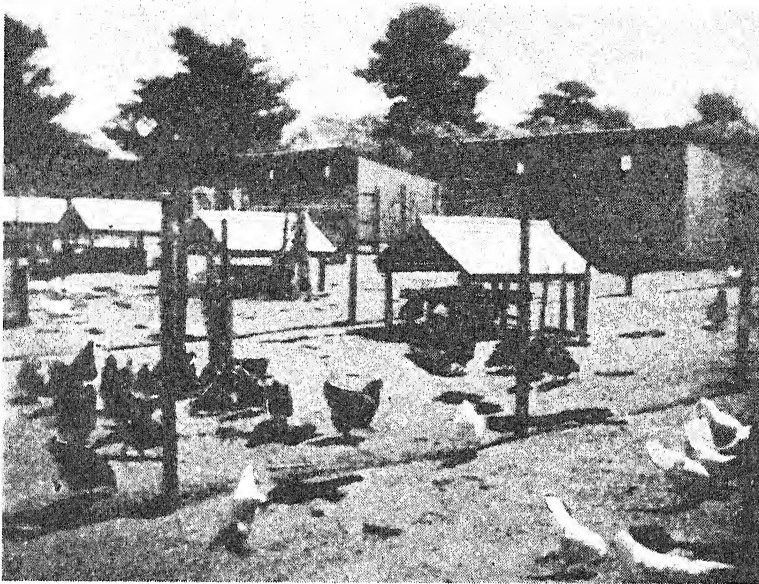
The 1947 March issue of this Journal contains an article outlining a series of poultry feeding experiments at present being conducted at Muresk Agricultural College. In the September issue, Dr. L. C. Snook discussed the rations being fed in these experiments in some detail.

The purpose of these articles was to provide a background for the present and subsequent articles which will present information gained from the experiments as they progress, and which will appear in this Journal at intervals during the next eighteen months.

To ensure continuity, readers are advised to refer to the two introductory articles mentioned, along with the present one.

The purpose of this article is to present information which the experiments have yielded during the first six months. At the moment certain trends are evident; these may or may not continue. The ensuing six months will help to complete the picture and the following year should reveal even more important information.

Readers are reminded that the experimental flock comprises 600 laying fowls, containing six experimental groups. Each group comprises 100 fowls, 50 of which are Australorps and 50 of which are White Leghorns. Portion of the experimental flock is shown in the accompanying photograph; the White Leghorns are housed in the even numbered pens and the Australorps in the odd numbered pens.



The term of the experiment will be two years.

The rations being fed on a weight basis are as follows :—

TABLE 1.

Pens.	Group.	Bran.	Pollard.	Wheat-meal.	Meat-meal.	Crushed Peas.	Wheat.	Crushed Oats.	Bone-meal.	Ground Limestone.	Salt.	Approx. Crude Protein.
1 and 2	I.	lbs. 30	lbs. 10	lbs. 50	lbs. 10	lbs.	lbs.	lbs.	lbs. 2	lbs. 3	lbs. 1	% 15.2
3 and 4	II.	30	10	....	10	....	30	20	2	3	1	15.0
5 and 6	III.	10	10	....	10	....	50	20	2	3	1	14.3
7 and 8	IV.	....	....	30	10	10	50	....	3	3	1	15.0
9 and 10	V.	....	....	....	10	....	90	....	3	3	1	13.8
11 and 12	VI.	....	....	....	10	....	60	30	3	3	1	13.5

CHANGE OF RATION GROUP II.

Shortly after commencing the experiments it was felt that more important information would be gained by substituting 20 lb. of crushed oats for 20 lb. of wheat in the ration fed to Group II. (refer Table I.).

It is unfortunate that this change eliminates the possibility of determining if whole wheat is an economical substitute for wheatmeal, but it does provide a means of obtaining further information on the economy of using oats as part of the grain fraction in the laying hens diet.

DIFFICULTIES EXPERIENCED IN FEEDING THE RATIONS.

A practical difficulty arose with the feeding of the meatmeal-bonemeal-ground limestone-salt mixture at a 16 per cent. level of the ration fed to the birds in pens 7-12 inclusive. (Refer Table I.). The solution should be of interest to readers.

During the initial period of the experiments the above mentioned mixture was mixed with the grain and the greater part of the rations in this form was placed in self-feeders where the birds partook of it, *ad lib*. Each morning a small quantity of the respective rations was damped and fed to the birds in each of the six pens.

Two problems became manifest.

1. The meatmeal-mineral mixture gradually separated out from the grain in the self-feeders and within a week or two the concentration of the meatmeal-mineral mixture in the bottom of the feeder was such that the birds were disinclined to eat from the hopper.

When the meatmeal-mineral mixture was fed separately in the dry form, the birds ate only 5 per cent. instead of the desired 16 per cent.

The problem was solved by damping the greenfeed which is fed each evening and mixing with it an appropriate amount of the meatmeal-mineral mixture.

This method of feeding the meatmeal is proving most satisfactory as the greenstuff is readily eaten and with it the meatmeal-mineral mixture at the desired level.

This problem recalls work carried out at the Victorian Government Experimental Farm at Werribee by W. O. Pederick and A. G. Clark. These workers found that meatmeals having a crude protein content of less than 60 per cent. were unpalatable to birds fed only whole grains and meatmeal. This probably accounts for the non-palatability of the meatmeal under question, samples of which have yielded an average crude protein content of 50 per cent. on a dry basis.

2. It was stated above that a small quantity of the respective rations was damped and fed to the birds in each of the six pens, 7-12 inclusive. While pens 1-6 inclusive eat their mash at the rate of half a kerosenetinful per 50 birds it was found that pens 7-12 inclusive could only manage one-eighth kerosenetinful of their damped grain ration each morning, and even then some of their grain ration was left in the troughs until late afternoon, by which time the meatmeal-mineral mixture had separated from the grain due to drying and was consequently left behind in the trough.

The feeding of the damped grain to birds in pens 7-12 inclusive has been discontinued with a consequent saving in labour. These birds now take their full grain ration from the self-feeders and their meatmeal-mineral mixture with the greenfeed as outlined above.

MOULT.

All pens moulted following the change on to the experimental rations. The moult was not severe and the birds comprising Group I. were least affected. This was expected as the birds in this group were previously on a ration similar to the experimental ration. Generally speaking, the White Leghorns suffered more than the Australorps as a result of this change although pens seven and 11 were still showing signs of the moult during the first week in June.

By mid-June all the birds were through the moult but birds from pens 10 and 12 were slow to develop as indicated by their egg production at that time (*see* Graph II.).

SICKNESS, MORTALITIES, AND REPLACEMENT OF BIRDS.

The general health of the flock has been good. Pen six has been unfortunate in that it has lost a number of birds from a variety of causes. Colds were evident in this pen during July and August followed by a mild outbreak of chicken-pox during September. Mild colds were present amongst birds of the remaining five pens of White Leghorns during July and August.

To the 15th July, three and a half months after the commencement of the experiment, seven Australorps and 12 White Leghorns had died from a variety of causes such as :—internal laying, peritonitis, protrusion of the oviduct with consequent cannibalism, fatty infiltration of the liver, etc., but no suspicion could be placed on the experimental rations as a possible cause of death. All these birds were replaced, so that on 15th July all pens were entire with 50 birds each. No replacements were made after this date.

Table 2 shows the number of birds left in each pen at the end of September.

TABLE 2.

Pen Number.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
No. of birds left in each pen at the end of September	49	50	50	49	50	43	50	47	48	50	50	50
No. of laying days lost by each pen through broodiness	135	45	90	15	90	15	75	15	120	15	60	30

MATURITY OF THE BIRDS.

Although the White Leghorns are only two weeks younger than the Australorps they were very much slower in coming into production and at the commencement of the experiments very few of the White Leghorns were laying, whereas the majority of the Australorps had been laying for a number of weeks. As Graph 2 shows, it was not until the beginning of July that the majority of the White Leghorns showed a satisfactory lay.

BODY DEVELOPMENT.

The experimental birds at the end of September were 12 months old and could then be regarded as mature.

TABLE 3.

Pen Number.	Average Body Weights at commencement of Experiment.	Average Body Weights at end of 6 months.	Mash and/or Grain Consumption.	Crude Protein Content of the Respective Rations.
	lb.	lb.	lb.	%
1	4.7	6.5	3,252½	15.2
2	3.0	4.5	2,520	15.2
3	4.9	6.3	3,280½	15.0
4	3.0	4.0	2,416½	15.0
5	4.8	6.0	2,832½	14.3
6	3.0	3.9	1,946½	14.3
7	4.9	5.8	2,533½	15.0
8	3.0	3.9	2,002	15.0
9	4.6	5.6	2,347½	13.8
10	3.0	3.6	1,877	13.8
11	4.9	5.6	2,540½	13.5
12	2.9	4.0	2,279½	13.5

From Table 3 we can arrive at the following conclusions :—

1. That the body weight increase of the birds under test has not been consistent.
2. That the body weight is apparently closely associated with food consumption.
3. That the general body weight may be associated with the protein content of the rations.

Two inconsistencies are obvious :—

1. In comparison of figures for pens five and seven, it can be seen that the high protein content of the ration fed to pen seven has evidently not been responsible for the average body weight increase that we would expect.

This can possibly be explained by the fact that the inclusion of peas in the ration fed to pen seven has contributed considerably towards its high protein content ; also the egg production from pen seven has been slightly higher than from pen five.

Complete knowledge of the influence of peas in regard to body building and egg production is not available.

2. The relatively good growth exhibited by birds from pen 12 might be partly explained by the fact that these birds have so far produced fewer eggs than any other pen, when their egg production is compared with that of the birds in pen four, which have the same average body weight, we find that pen four, by laying 2,546 eggs in six months has laid 703 more eggs than pen 12 for the same period.

More detailed work would be necessary to determine the exact influence of the proteins provided in these rations on body development, also the possibility of genetic factors influencing the development of the birds must not be overlooked in work of this kind.

BROODINESS.

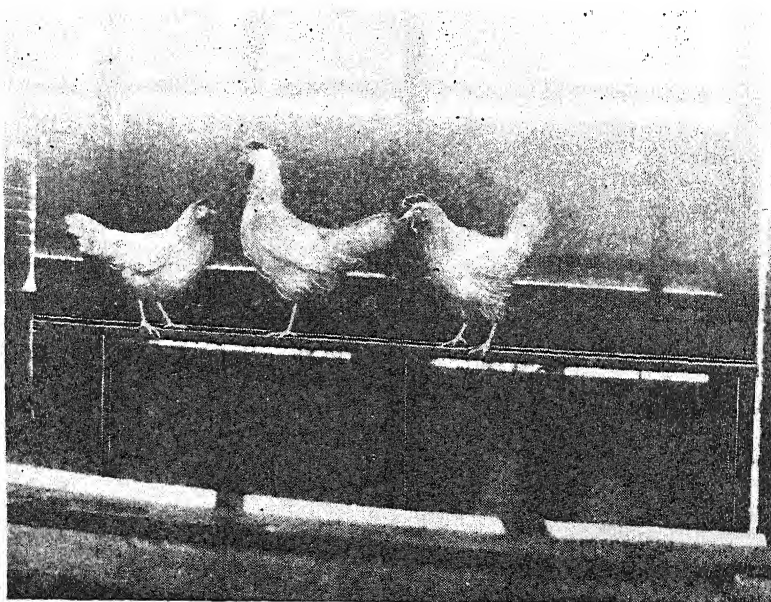
For the first six months of the experiments, broodiness has not affected production to any extent. With summer fast approaching, this factor is sure to play an important part in reducing the number of "laying days" available to all pens, in particular those containing Austrlorps.

Experimental evidence and past records of Muresk Egg Laying Trials indicate that on the average, 15 "laying days" are lost when a fowl goes broody, provided that she is detected and placed in the "broody coop" early.

The approximate number of "laying days" lost by each pen during the first six months of the experiments and shown in Table 2, are worked out on this basis. At the first sign of broodiness the suspected bird is placed in an isolated coop with a slatted floor. She remains in this coop until signs of broodiness have left her, usually three to five days.

NESTING.

Nesting facilities in all pens are as illustrated in the accompanying photograph.



The birds are resting on a platform prior to entering the nests which can be seen in the background. Part of a dry mash hopper can be seen to the left. These hoppers are provided with conical tops to prevent the birds roosting on them at night.

Each nest is 16in. square. Six such nests serve the 50 birds in each pen. Each nest is fitted with a removable iron tray. Each tray contains clean, dry sand to a depth of approximately 2in. The use of this type of nest has resulted in few dirty and broken eggs. With this type of nest it is essential that inter-nest partitions be high enough to prevent a hen from one nest using her beak in an attempt to rob an egg from an adjacent nest.

In front of the nests a light wooden frame with wire-netting attached, is hinged so that it can be lowered to prevent the birds occupying the nests at night.

The nests being open front and back provide sufficient ventilation to keep the birds reasonably cool while on the nest during hot weather.

VALUE OF FOODSTUFFS CONSUMED.

Monthly retail prices of foodstuffs consumed by the experimental birds have been kindly supplied by Westralian Farmers Co-operative, Ltd. These prices were used in determining the cost of food consumed by each pen and shown in Tables 4 and 5.

TABLE 4.

Pen No.				Value of mash and/or grain consumed.	Value of green feed consumed.	Value of eggs laid.	Profit, value of eggs laid over total value of food consumed.
				£ s. d.	£ s. d.	£ s. d.	£ s. d.
1	...	...	...	16 5 2½	1 2 10½	39 2 10½	21 14 9½
2	...	...	...	12 2 0½	1 2 10½	24 18 4	11 13 5
3	...	...	...	16 5 3	1 2 10½	24 18 4½	15 8 2½
4	...	...	...	12 3 3½	1 2 10½	20 8 7	7 2 5½
5	...	...	...	14 19 9½	1 2 10½	34 11 6	18 8 9½
6	...	...	...	10 6 9	1 2 10½	18 11 4½	7 1 9
7	...	...	...	16 0 9½	1 2 10½	36 4 11	19 1 3½
8	...	...	...	12 16 5½	1 2 10½	18 12 2½	4 12 10½
9	...	...	...	12 18 8½	1 2 10½	28 7 8½	14 6 1½
10	...	...	...	10 6 8½	1 2 10½	15 12 6	4 2 11
11	...	...	...	14 9 1½	1 2 10½	28 7 9	12 15 8½
12	...	...	...	12 19 5½	1 2 10½	14 17 9	0 15 4½

Average prices for the various foodstuffs used over the six monthly period are as follows :—

	£ s. d.
Wheat	0 6 6 per bushel
Feed oats (guyra)	0 4 5 per bushel
Meatmeal	15 15 0 per short ton
Field peas	0 16 6 per bushel
Bran and Pollard	0 1 6½ per bushel
Bonemeal (100 lb. bags)	0 18 0 per bag
Ground Limestone	0 0 0½ per lb.
Salt	0 0 0½ per lb.

For the first three months of the experiments, 3d. per bushel was allowed to cover the cost of crushing the grain used in the rations. Today it would appear that 5d. per bushel is a more exact figure to work on, consequently as from 1st July and until further notice 5d. per bushel will be added to the price of all grain which is crushed before being fed.

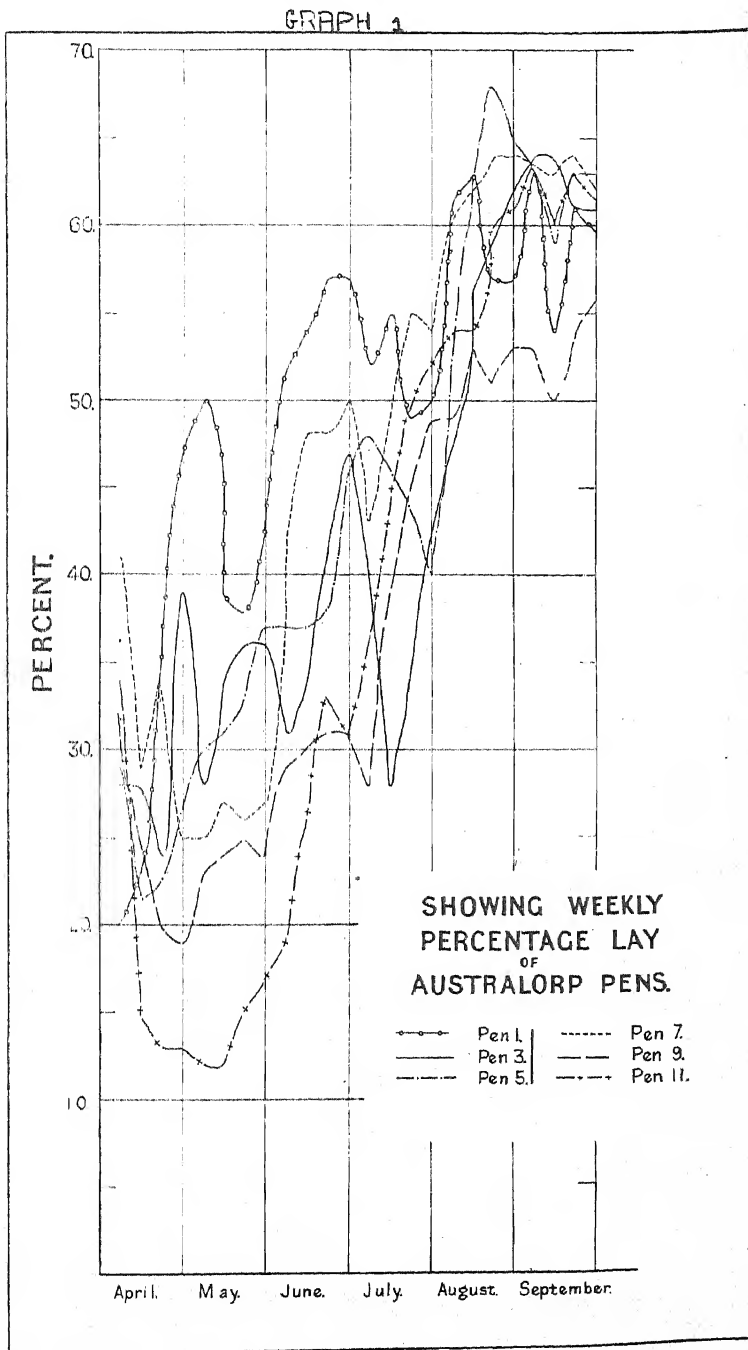
Table 5 shows the amount and value of foodstuffs consumed, the number of eggs laid and their value, also other information relating to the experiments which may be of interest to readers.

TABLE 5.

	Australorps.	White Leghorns.	All Pens.
No. of Birds	300	300	600
Mash and/or Grain consumed in lbs. ...	16,786½	13,041½	29,828½
Value of mash and/or grain consumed ...	£90 18s. 11d.	£70 14s. 8½d.	£161 13s. 7½d.
Green Feed consumed in lbs.	4392	4392	8784
Value of green feed consumed at 3d. per kerosene tin full (8 lbs.)	£6 17s. 3d.	£6 17s. 3d.	£13 14s. 6d.
Total food consumed in lbs. ...	21,178½	17,433½	38,612½
Total cost of food consumed	£97 16s. 2d.	£77 11s. 11½d.	£175 8s. 1½d.
Total food consumed per bird per day in ozs.	6.2	5.1	...
Total food cost per bird per week ...	3d.	2¾d.	...
Eggs laid in doz	1971	1163½	3134½
Value of eggs laid	£199 11s. 1½d.	£113 0s. 9½d.	£312 11s. 10½d.
Cost of marketing these eggs at 3½d. per dozen	£28 14s. 10½d.	£16 19s. 3½d.	£45 14s. 2d.
Profit over food cost	£101 14s. 11½d.	£35 8s. 9½d.	£137 3s. 9d.
Profit over food and marketing costs ...	£73 0s. 0½d.	£18 9s. 6½d.	£91 9s. 7d.
Net profit per bird for 6 months on this basis	4s. 10½d.	1s. 2¾d.	3s. 0½d.
Mash and/or grain consumed per egg laid in ozs.	11.3	14.9	12.7
Total food consumed per egg laid in ozs	14.3	19.9	16.4
Total food cost per dozen eggs laid in pence	11.9	16	13.4
Mash and/or grain consumed per bird per week in lbs.	2.1	1.7	1.9
Mash and/or grain consumed per bird per day in ozs.	4.8	3.9	4.3

When referring to Table 5, readers are reminded that due to the slow development of the White Leghorns under test, there was a big difference in the numbers of eggs laid by the two breeds under consideration, for the six months concerned.

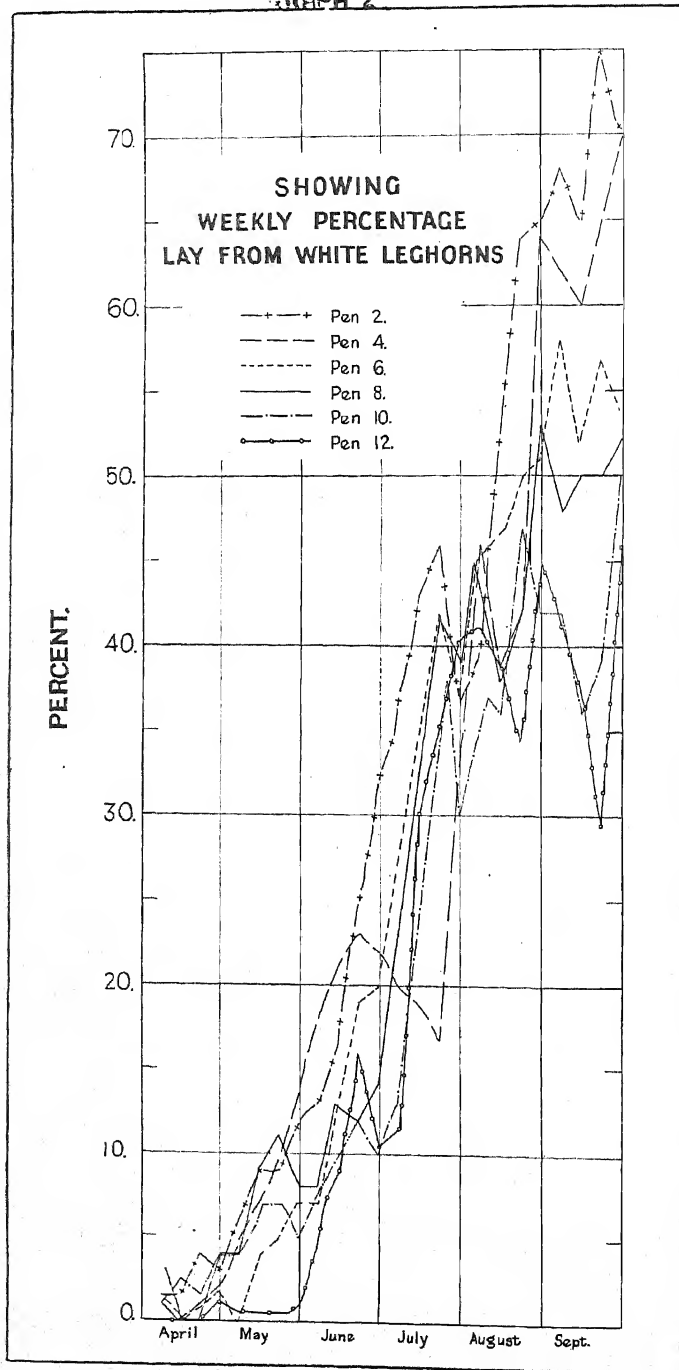
Comparison of graphs 1 and 2, show this difference and also that two pens of White Leghorns (Pens 2 and 4), were producing better than the best pen of Australorps at the end of September. It is highly likely that the production costs for the second six months for the two breeds will be much closer than for the first six months.



Graph I.

Note the initial falling off in production by all pens except Pen 1 following the change on to the experimental rations, also the loss of production to Pen 3 brought about by the change of ration fed this pen on 16th June. With the White Leghorns in Pen 4 (see Graph II.) production dropped in a similar manner.

GRAPH 2



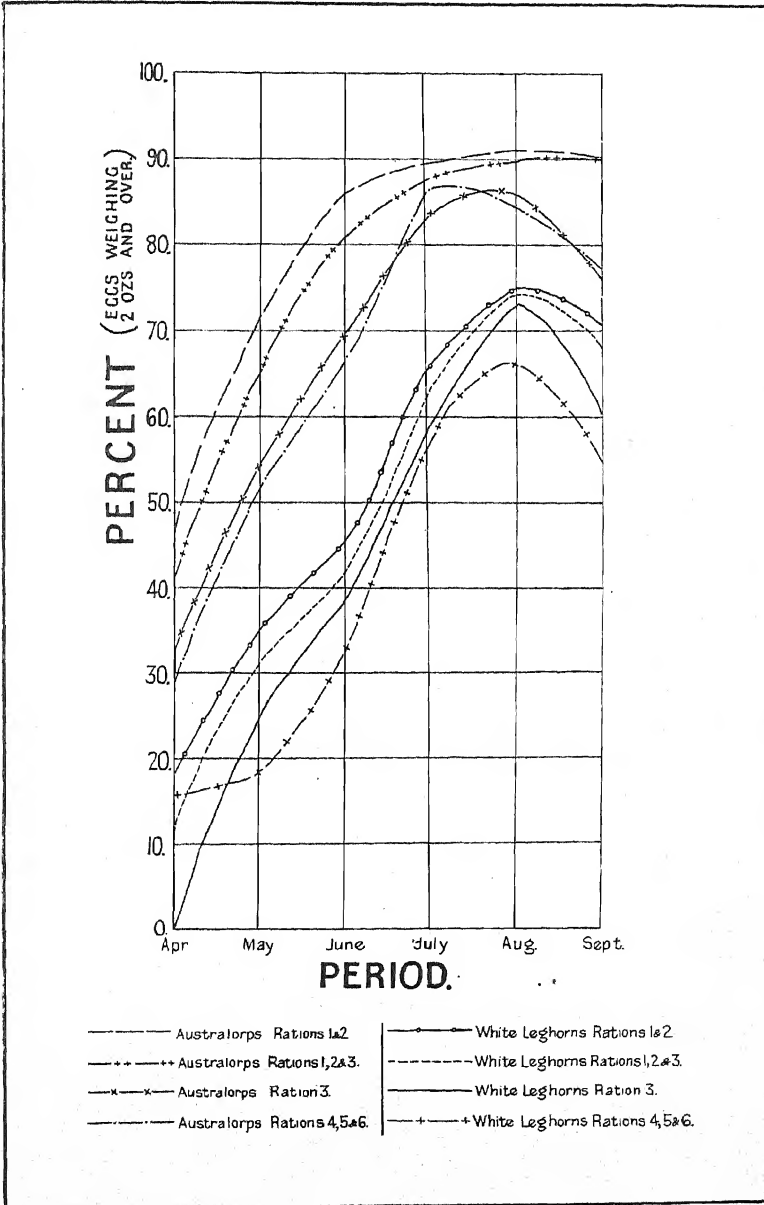
Note the big variation in percentage lay for the White Leghorn pens at the end of September. Compare this with the Australorps (Graph I.).

EGG SIZE.

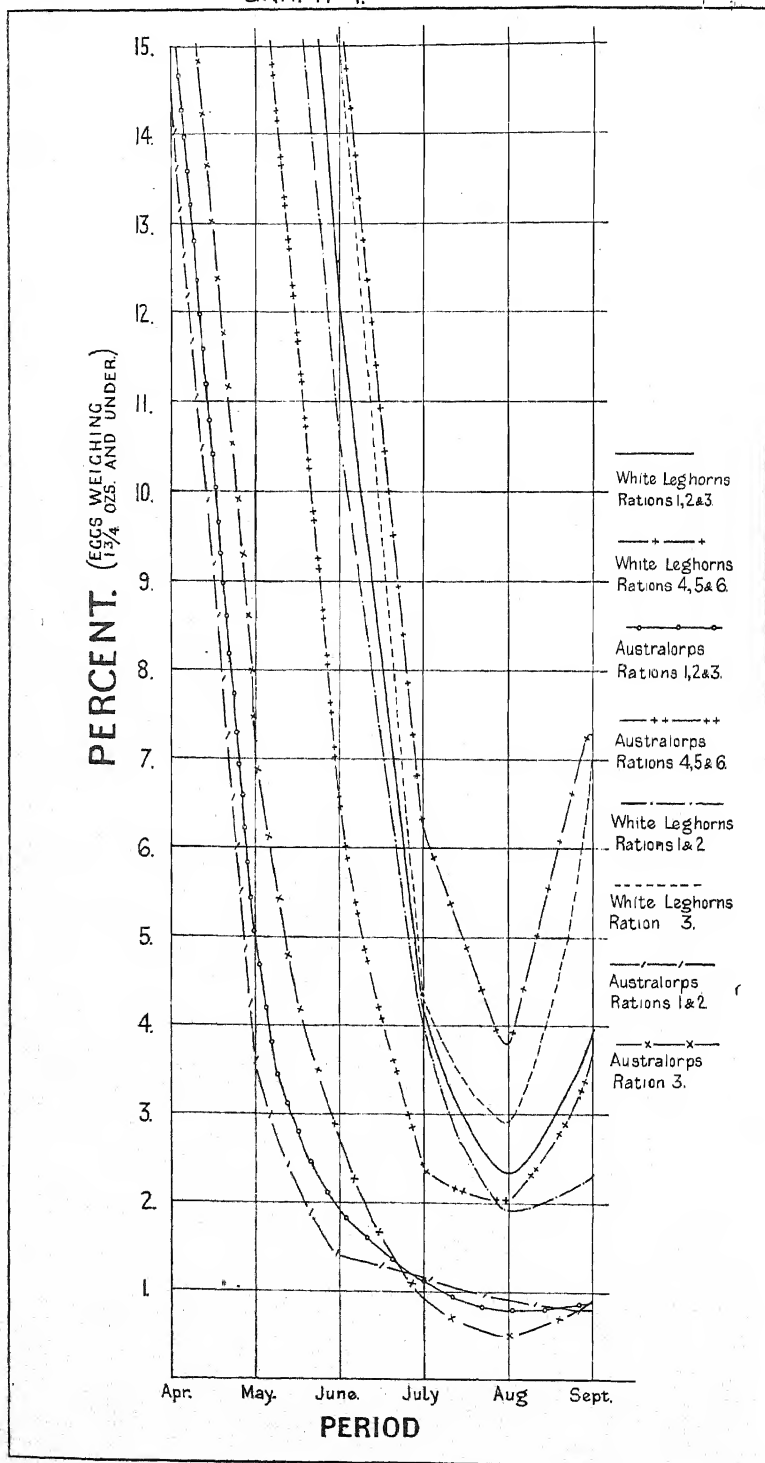
From Graph 3 where the percentage of eggs weighing 2 oz. and over has been graphed with the period in which they were laid, it can be seen that with both breeds :—

- (a) Rations 1, 2 and 3 (see Table 1), produced a greater percentage of eggs weighing 2 oz. and over than did rations 4, 5 and 6.
- (b) Rations 1 and 2 were superior to Ration 3 for the purpose of producing larger eggs.

GRAPH 3.



GRAPH 4.



These findings suggest that mill offal, when introduced into the ration, would result in an increase in egg size.

From Graph 4, where the percentage of eggs weighing $1\frac{1}{4}$ oz. and under has been graphed with the period in which they were laid, the conclusions support those drawn from Graph 3.

A reduction of 20% (by weight) bran in ration 3 as compared with Rations 1 and 2, resulted in a greater percentage of smaller eggs being laid by both Australorps and White Leghorns (Pens 5 and 6) on this ration. Actually the size of eggs laid by the fowls on Ration 3 is little in advance of that obtained from the group fed Ration 6, which consists mainly of wheat and crushed oats.

The exact influence that mill offal has on egg size could well be kept in mind for future investigation. In the meantime a trend of this is evident in the current experiments, the development of which will be interesting to follow.

THREE CLASSES OF SALEABLE EGGS.

1. Ninety-six per cent. of the eggs gathered that weighed $1\frac{3}{4}$ ozs. and over were regarded as "hen" eggs, "first grade."
2. The remaining 4 per cent. of the "hen" eggs were regarded as "second grade." Past Muresk egg laying records of individually penned fowls indicate that 2-3 per cent. of "hen" eggs laid are sold as "second grade," under flock conditions, 4 per cent. would seem a reasonable figure to take.
3. All eggs weighing under $1\frac{3}{4}$ ozs. were regarded as "mediums."

VALUE OF EGGS LAID.

The value of eggs laid was based on wholesale prices ruling for the three classes of eggs listed above at the time of laying.

COST OF MARKETING EGGS.

Marketing charges per dozen eggs amount to approximately 3½d. in the Metropolitan Area and 4½d. in the country. Three and a half pence per dozen has been allowed to cover the cost in these experiments.

GENERAL.

It will be observed from the foregoing that the experiments have progressed for six months and it is proposed to continue them until March, 1949.

It is necessary to emphasise that the report given above is in respect of continuing experiments and the results shown should not therefore be taken as final.

It is possible that the conclusions arrived at may be considerably altered at the termination of these experiments.

ACKNOWLEDGMENTS.

Grateful acknowledgment is made to Messrs. K. Cowin, M. Johnson and P. Thomson for their ready co-operation in this work.

VETCHES

By I. THOMAS, Superintendent of Wheat Farming.

For many years field peas and lupins have been the only legume plant species which have been grown to any marked extent for grain purposes. Under certain conditions both these plants have some disabilities and endeavours have been and still are being made, to provide alternative legume species which will prove more successful under all types of conditions.

During 1945, a small quantity of each of five varieties of vetch obtained the previous year from the Hawksbury Agricultural College, Nee South Wales, as planted at the Avondale Research Station. One of these vetches, designated by the number P4059, appeared to be the most prolific and promising variety, and during 1946 a small area was planted and 170 lb. of seed harvested.

The 170 lb. of seed obtained was used to plant a 5 acre plot at Wongan Hills Research Station during the 1947 season, the seeding rate used being approximately one half bushel per acre. The seed was planted during May on an area of fallowed land, a good germination resulted and subsequent growth was satisfactory, and by the Spring, excellent returns were anticipated.

Harvesting was carried out during November, though some of the pods were immature, but as a certain amount of the seed had already shed, it was considered desirable to carry out this operation. Care was taken to see that the immature portion was dried before bagging.

The yield from the five acres was just over 34 bushels.

From this year's experience, it would appear that vetches are a relatively easy crop to cultivate, including harvest. For harvesting operations the ordinary header harvester, equipped with light iron crop lifters and with every other tooth taken out of the comb, was used.

This variety of vetch appears to have definite possibilities as a substitute crop for field peas as it is immune to attacks by the pea weevil and has a good measure of resistance to red mite. In another article in this issue of the Journal, the feeding value is discussed from which it would appear that it is a valuable addition to the sources of stock foods high in protein.

Being a legume its cultivation will materially assist in building up the soil fertility and could possibly be used to advantage in soil conservation work.

Further trials and plantings of this strain of vetch in different districts of the wheatbelt during the coming season will be watched and noted with considerable interest.

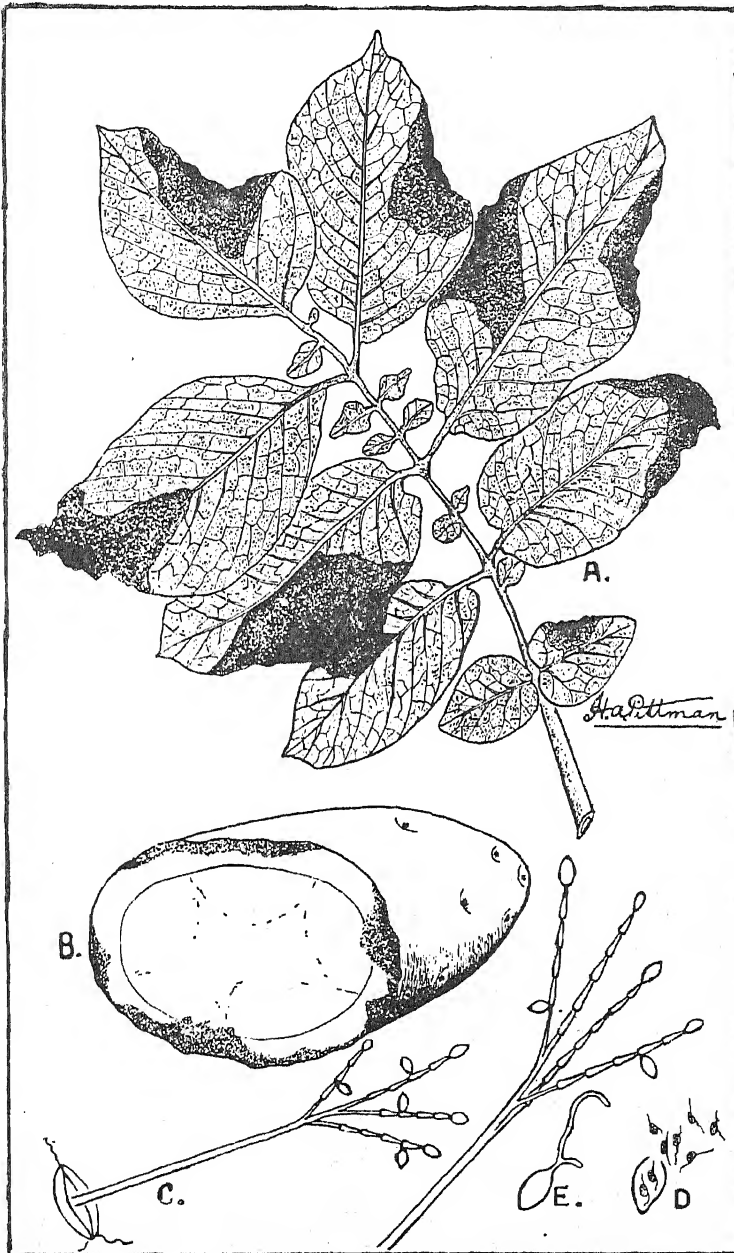
LATE OR IRISH BLIGHT OF POTATOES

W. P. CASS SMITH, Government Plant Pathologist.

IRISH Blight, also referred to as Late Blight is the most destructive and spectacular disease of potatoes in many parts of the world.

The term Irish as applied to this disease relates to the devastating epidemic which in 1844 and 1845 destroyed potato crops in Ireland, and Western European countries. In Ireland famine resulted from the wholesale crop failures, and as a direct result, people died of starvation, political strife ensued, and emigration to America and other parts of the world commenced.

The disease, which is caused by a fungus *Phytophthora infestans*, is encouraged by warm muggy weather during the day, and relatively cool temperatures at night. Fortunately it has so far proved to be uncommon in Western Australia, as climatic conditions for its full development are seldom ideal for lengthy periods. Serious outbreaks in the past, have been confined mainly to the districts adjacent to Perth and have all occurred during the period August to mid-November.



Explanation of Figures.

Fig. 1.—"Irish blight" of potatoes caused by *Phytophthora infestans*.

A, Potato leaf showing "Irish Blight."

B, Potato tuber showing the reddish-brown areas of dry-rot due to *Phytophthora infestans*.

C, Fruiting-branch of the fungus protruding from a breathing-pore in a potato leaf.

D, Formation of zoospores on germination of a sporangium.

E, Germination of spore under warm conditions by a germ-tube. (All parts of the fungus highly magnified.)

(After Pittman).

SYMPTOMS.

Leaves, petioles, stems, blossom-stalks and tubers may be attacked. On the leaves, dead, brown or blackish more or less extensive, collapsed, water-soaked areas occur which usually commence near the margins of leaves and rapidly work inwards. (See Figs. 1A and 2.) If the weather conditions subsequently become hot and dry the dead areas may wither and dry up, but if humid conditions continue they

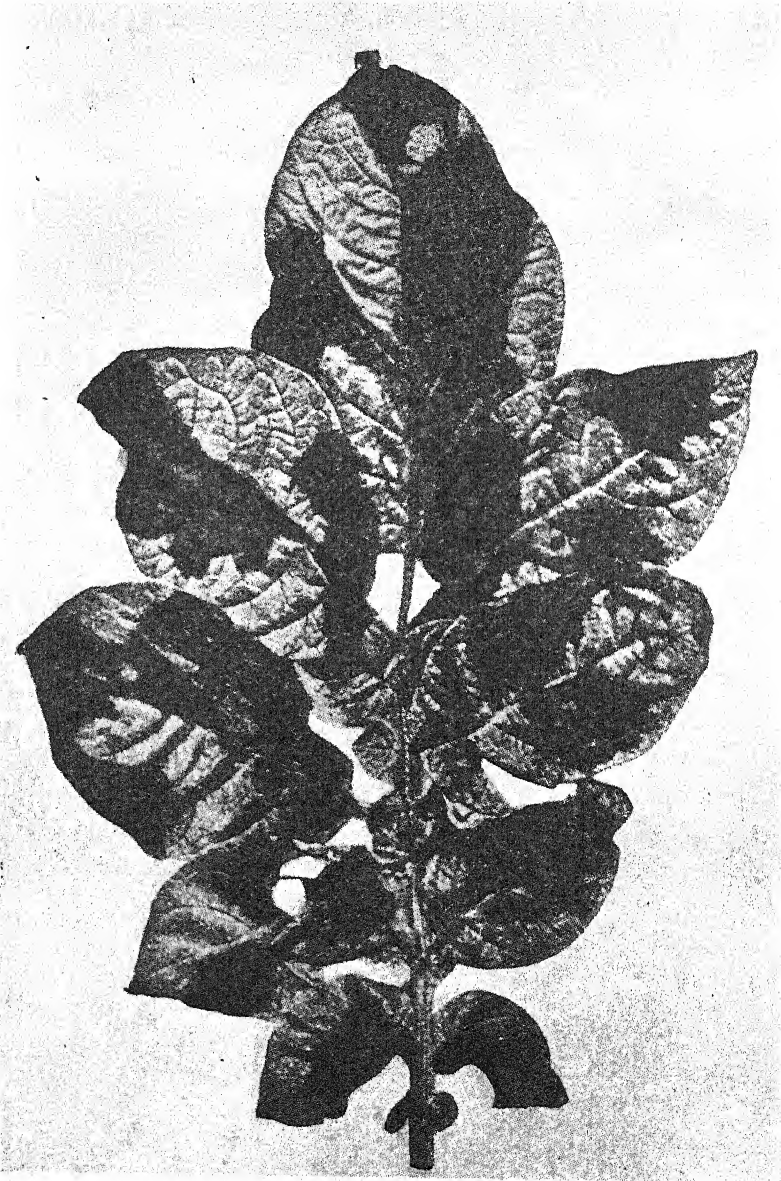


Fig. 2. Potato leaf showing symptoms of Irish Blight. (After Kirk.)

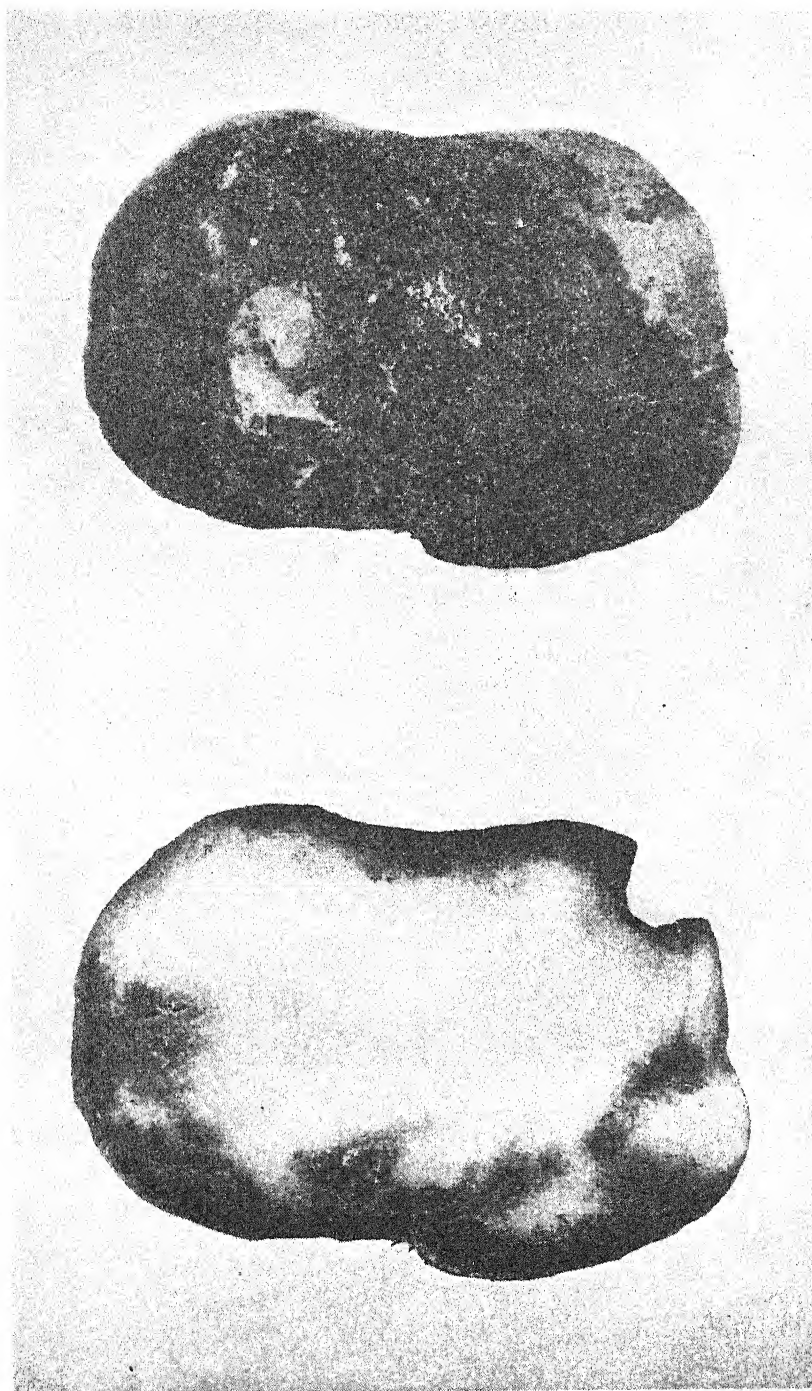


Fig. 3.—Potato tuber showing external and internal symptoms of Irish Blight (After McAlpine).

may rapidly rot away with the evolution of a characteristic offensive odour. Infection usually first takes place on the lower leaves. In warm muggy weather the disease advances very rapidly, and the entire tops may soon become blackened and collapsed (see Figs. 2 and 5), followed by a wet rot involving the stems as well as the foliage. If affected leaves are examined after being placed in a moist jar overnight, or even after a cold night in the field, great quantities of delicate white mould may be found on the under surfaces and especially along the margins between the dead and healthy tissue. This is composed of the spore-bearing bodies (*sporangiophores*) of the fungus which have grown out overnight through the *stomata* or breathing pores of the leaves. (See Fig. 1c.) The spores (*sporangia*) readily break away from the *sporangiophores*, and are carried in the dew, or by wind or rain, to the soil or neighbouring leaves or plants. On germination each *sporangium* produces a number of actively motile animal-like bodies called *zoospores*, which swim about in the moisture until in a favourable position to attack new areas. (See Fig. 1b.) Each then settles down, forms a cell-wall about itself, and pushes out a thread or *hypha* which proceeds by growth to penetrate the host, and subsequently extend the disease.

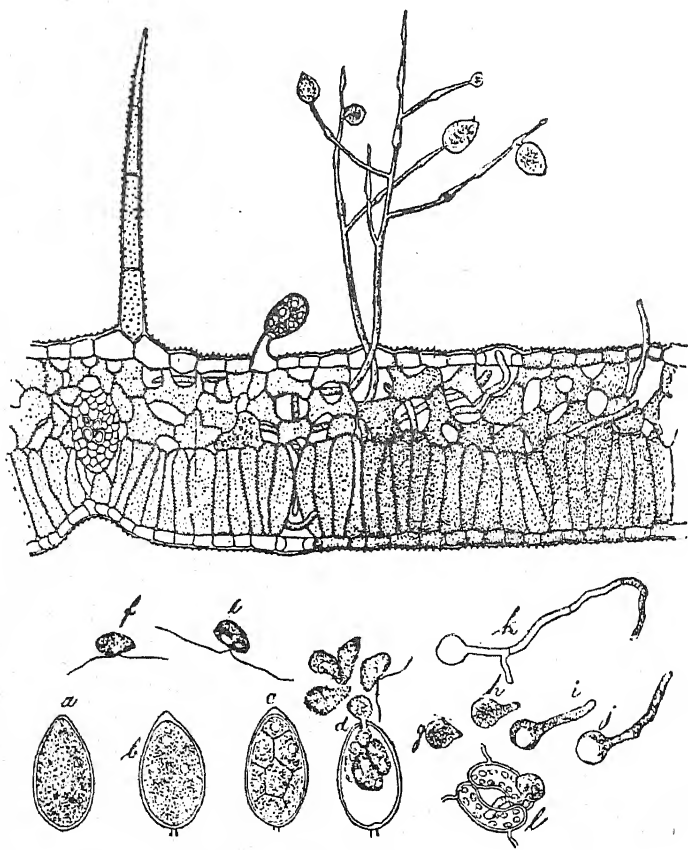


Fig. 4.—Section of potato leaf showing fungus within leaf and also method of production of fruiting bodies and *zoospores* by the fungus. (After Scribner).

Under high temperatures the *sporangium* may germinate directly by a germ-tube instead of forming *zoospores* (i.e., it may function as a *conidium*.) (See Fig. 1E.) The threads of the fungus grow about between the cells of the host and absorb food materials by means of absorbing structures, called *haustoria*. (See Fig. 4.) So great are the demands on the host that death of the cells rapidly follows.

The disease may prove disastrous in two ways. Firstly, if attack comes early in the season the yield of tubers may be greatly reduced on account of the killing of the leaves and stems. Secondly, very serious loss may result from direct attack on the tubers themselves. *Sporangia* may be washed down into the soil by rains and dews, and on germination the *zoospores* may bring about direct infection of the tubers. A *dry or wet rot* may result according to the moisture and temperature conditions in the soil at the time. Where the soil is heavy, damp and warm, complete disintegration of the tubers may speedily result. Under conditions less favourable to the organism, the disorganisation and characteristic reddish-brown discoloration of the tissues may only occur to a depth of about $\frac{1}{8}$ in. to $\frac{1}{4}$ in. (see Figs 1b and 3). In such cases the diseased tubers remain comparatively firm, but the surface may be slightly sunken and become somewhat purplish-black in colour. This *dry-rot* condition may be evident on digging or may only become clearly



Fig. 5.—Showing effect of Bordeaux mixture in preventing attack by Irish Blight. Plants on left and right sprayed with Bordeaux; those in centre not sprayed. (After Duggar.)

apparent after some time in storage. Cool, well aerated, dry storage conditions materially check the dry-rot symptoms from further development, but if the conditions are damp, complete destruction of the whole stack may speedily follow. This is, of course, largely assisted by secondary organisms, which follow up the initial injuries caused by the *Phytophthora*.

The disease appears to be carried over from year to year by means of fungus-threads, which hibernate within affected tubers. When such tubers are planted the threads of the fungus (*mycelium*) grow up the developing shoots and, under

favourable conditions, produce the *sporangia*, thus starting the disease in the new season's foliage. If the mean day temperatures lie between about 70° and 74° F., the humidity is high, and the night temperatures fall to about 50° F. the blight may speedily attain epidemic form.

CONTROL OF IRISH OR LATE BLIGHT.

Although Irish Blight has proved uncommon in the past this state of affairs may not always continue. Should the climatic conditions ever become favourable for the disease for a week or so on end great damage might result. The growers should, therefore, be prepared to take action against the parasite should it make its appearance during warm, muggy weather.

1. The disease can be readily controlled by spraying with copper fungicides (see Fig. 5). Either *Bordeaux Mixture* (copper sulphate 4 lbs.; quick lime 4 lbs. or hydrated lime 6 lbs.; water 40 gals.), or *Burgundy Mixture* (copper sulphate 4 lbs., washing soda 5 lbs., water 40 gals.) are suitable.

The action of the spray is protective, not curative and hence the first application must be given *immediately* the disease appears in view of its capacity for rapid spread. Application should be repeated frequently, during weather conducive to its development, in order to keep the new growth covered with spray.

2. If the tops become badly attacked towards the close of the season and dry weather follows, the tubers should not be harvested till a week or more after the tops are dead, as the risk of extensive infection of the tubers, with subsequent rotting in storage, is then considerably reduced owing to the killing of the *sporangia* by the dry weather. Where only small areas are affected the tops should be cut away and burnt before the tubers are harvested.

3. If the tubers must be harvested shortly after attack, cutting away and burning the tops, combined with spraying of the soil with Bordeaux or Burgundy mixture before digging, will considerably reduce the percentage of affected tubers.

4. Care should be taken to keep the plants well hilled up, so as to prevent the *sporangia* readily reaching the tubers.

5. After digging, the potatoes should be kept in a cool dry place to reduce the rotting in storage to a minimum. Tubers stored at 40° F. or lower only rot very slowly, even if fairly badly attacked. **Never, on any account, place the leaves or stems of potato plants in the tops of the bags.**

6. Potatoes from a diseased crop should not be used for seed unless no others are available. In this case any showing brown discolouration on cutting should be culled out from the seed tubers and destroyed by boiling.

Fertilisers.

The following fertilisers have been registered at the Department of Agriculture under the Fertiliser Act, 1928, for the year commencing 1st November, 1947:—

Name of Fertiliser.	Reg. No.	Brand.	By whom Registered.	Nitrogen (N) as			Phosphoric Acid (P ₂ O ₅) as			Potash (K ₂ O) as		Cash Price per ton at Works or on Rail or on Perth.		
				Ni- trate.	Am- monia.	Blood and Bone.	Bone Dust	Water Sol.	Citrate Sol.	Acid Sol.	Total.		Sul- phate.	Mur- ate.
A.—MINERAL.														
1. Nitrogenous.														
(a) Nitrogen as Nitrate :														
Nitrate of Soda	12	Mt. Lyell as M.L.	Cunning Smith & Mt. Lyell F.F. Ltd.	15.5	...	...	...	...	...	...	...	...	18 10 0 W
do.	24	C.S.M.L.	do.	15.5	...	...	...	...	...	...	...	...	18 10 0 W
do.	35	Sickle	do.	15.5	...	...	...	...	...	...	...	...	18 10 0 W
do.	39	Champion	R. Dundas Smith & Son	15.20	...	...	...	...	...	...	...	...	22 10 0 P
do.	48	Cresco	Cresco Fertilisers Ltd.	15.5	...	...	...	...	...	...	...	...	18 10 0 W
do.	57	Fauldings	F. H. Faulding & Co.	16.00	...	...	...	...	...	...	...	...	1 17 4 P
Sodium Nitrate														
(b) Nitrogen as Ammonia:														
Sulphate of Ammonia	5	I.C.I.A.N.Z.	Cunning Smith & Mt. Lyell F.F. Ltd.	20.5	...	...	...	...	...	...	...	...	18 0 0 W
Do.	51	Cresco	Cresco Fertilisers Ltd.	20.5	...	...	...	...	...	...	...	...	18 0 0 W
Ammonium Nitrate	58	Fauldings	F. H. Faulding & Co.	30.00	...	...	...	...	...	...	...	...	3 5 4 P1
Sulphate of Ammonia	59	do.	do.	20.0	...	...	...	...	...	...	...	...	1 12 8 P1
2. Phosphatic.														
(a) Rock Phosphate.														
Phosphate Powder														
(b) Superphosphate.														
Superphosphate 19%	6	Mt. Lyell as M.L.	Cunning Smith & Mt. Lyell F.F. Ltd.	...	...	...	...	15.00	2.50	1.5	19.00	...	5 8 6 W
Do.	7	do.	do.	...	...	...	...	17.00	2.5	1.5	21.00	...	6 1 0 W
Do.	14	C.S.M.L.	do.	...	...	...	...	15.00	2.5	1.5	19.00	...	5 8 6 W
Do.	15	do.	do.	...	...	...	...	17.00	2.5	1.5	21.00	...	6 1 0 W
Do.	25	Sickle	do.	...	...	...	...	15.00	2.5	1.5	19.00	...	5 8 6 W
Do.	28	do.	do.	...	...	...	...	17.00	2.5	1.5	21.00	...	6 1 0 W
Do.	29	Sickle	do.	...	...	...	...	15.00	2.5	1.5	19.00	...	5 8 6 W
Do.	42	Cresco	Cresco Fertilisers (W.A.) Ltd.	...	...	...	...	15.00	2.5	1.5	19.00	...	6 1 0 W
Do.	43	Cresco	do.	...	...	...	...	17.00	2.5	1.5	21.00	...	6 1 0 W
Do.														
(c) Superphosphate and														
Mixtures.														
Superphosphate and Zinc	22	C.S.M.L.	Cunning Smith & Mt. Lyell F.F. Ltd.	...	...	...	...	16.00	2.25	1.5	19.75	Zinc 2.5	Man- ganese

FERTILISERS.—continued.

Name of Fertiliser.	Reg. No.	Brand.	By whom Registered.	Nitrogen (N) as				Phosphoric Acid (P ₂ O ₅) as				Potash (K ₂ O) as		Cash Price per ton at Works or on Rail at Perth.
				Ni- trate.	Am- monia.	Blood and Bone.	Horn Dust.	Water Sol.	Citrate Sol.	Acid Sol.	Total.	Sul- phate.	Muri- ate.	
Super and Manganese ...	50	Cresco	Cresco Fertilisers (W.A.) Ltd.	...	...	...	...	14.4	2.1	1.3	17.8	...	5.75	9 17 1 W
Do. do. ...	66	C.S.M.L. Sickle	do. do.	...	...	...	...	14.00	2.00	1.5	17.5	...	3.8	10 3 4 W
Do. do. ...	67	Sickle	do. do.	...	...	...	...	14.00	2.00	1.5	17.5	...	3.8	10 3 4 W
Super and Copper Ore	23	C.S.M.L.	Cuming Smith & Mt. Lyell F.F. Ltd.	...	...	...	...	14.00	2.00	1.5	17.5	...	1.60	8 3 10 W
Super and Copper No. 1	27	C.S.M.L.	do. do.	...	...	...	...	16.00	2.25	1.5	19.75	...	1.25	9 16 10 W
Super and Copper Ore	34	Sickle	do. do.	...	...	...	...	14.00	2.00	1.5	17.5	...	1.40	8 3 10 W
Super and Copper Ore	44	Cresco	Cresco Fertilisers (W.A.) Ltd.	...	...	...	...	14.00	2.00	1.5	17.5	...	1.60	8 3 10 W
Super and Copper ...	54	Cresco	do. do.	...	...	...	...	16.00	2.5	1.5	20.00	...	1.25	9 12 8 W
3. POTASSIC.														
(a) Potash as Sulphate.	13	Mt. Lyell as M.L.	Cuming Smith & Mt. Lyell F.F. Ltd.	...	...	...	...	...	...	...	...	30.00	...	16 13 0 W
Sulphate of Potash ...	25	C.S.M.L.	do. do.	...	...	...	...	...	...	...	...	30.00	...	16 13 0 W
Do. do. ...	30	Sickle	do. do.	...	...	...	...	...	...	...	...	30.00	...	16 13 0 W
Do. do. ...	52	Cresco	Cresco Fertilisers (W.A.) Ltd.	...	...	...	...	...	...	...	...	30.00	...	16 13 0 W
Do. do. ...	69	Chandler	The State (W.A.) Alumite Industry	...	...	...	...	30	...	...	...	...	...	24 0 0 W
(b) Potash as Muriate.														
Muriate of Potash ...	49	Cresco	Cresco Fertilisers (W.A.) Ltd.	...	...	...	...	...	...	...	...	...	60.0	29 17 5 W
4. NITROGEN AND PHOS- PHORIC ACID.														
Potato Manure No. 2 ...	9	Mt. Lyell as M.L.	Cuming Smith & Mt. Lyell F.F. Ltd.	...	3.5	...	...	11.75	2.00	1.5	15.25	...	...	8 16 3 W
Potato Manure "C" ...	18	C.S.M.L.	do. do.	...	3.5	...	...	11.75	2.00	1.5	15.25	...	...	8 16 3 W
Do. "C" ...	32	Sickle	do. do.	...	3.5	...	...	11.75	2.00	1.5	15.25	...	...	8 16 3 W
Do. "C" ...	47	Cresco	Cresco Fertilisers (W.A.) Ltd.	...	3.5	...	...	...	...	...	...	...	...	8 16 3 W
5. NITROGEN, PHOS- PHORIC ACID AND POTASH.														
Potato Manure "A" ...	8	Mt. Lyell as M.L.	Cuming Smith & Mt. Lyell F.F. Ltd.	...	2.5	...	...	10.00	1.75	1.25	13.00	5.00	...	10 3 4 W
Do. No. 3 ...	10	do.	do. do.	...	3.50	...	...	9.5	1.5	1.25	12.25	5.00	...	10 15 8 W
Do. "A" ...	16	C.S.M.L.	do. do.	...	2.5	...	...	10.00	1.75	1.25	13.00	5.00	...	10 3 4 W
Do. "B" ...	17	do.	do. do.	...	3.5	...	...	9.5	1.5	1.25	12.25	5.00	...	10 15 8 W

(P1) per cwt. at Perth.

(P) at Perth.

(W) at Works.

Do.	"A"	30	Sickle	do.	do.	2.5	...	10.00	1.75	1.25	13.00	5.00	...	10	3	4	W
Do.	"B"	31	Sickle	do.	do.	3.5	...	9.5	1.5	1.25	12.25	5.00	...	10	15	8	W
Do.	"A"	45	Cresco	Cresco Fertilisers (W.A.) Ltd.	...	2.5	...	10.00	1.75	1.25	13.00	5.00	...	10	3	4	W
Do.	"B"	46	Cresco	do.	do.	3.5	...	9.5	1.5	1.25	12.25	5.00	...	10	15	8	W
Orchard Manure	...	11	Mt. Jellies F.F. Ltd.	Cuming Smith & Mt. Lyell F.F. Ltd.	7.00	1.25	.75	9.00	5.00	...	12	10	9	W
Do.	...	19	C.S.M.L.	do.	do.	7.00	1.25	.75	9.00	5.00	...	12	10	0	W
Do.	...	33	Sickle	do.	do.	7.00	1.25	.75	9.00	5.00	...	12	10	0	W
Do.	...	33	Cresco	Cresco Fertilisers (W.A.) Ltd.	7.00	1.25	.75	9.00	5.00	...	12	10	0	W
Tomato Manure	...	20	C.S.M.L.	Cuming Smith & Mt. Lyell F.F. Ltd.	...	3.5	...	6.00	.75	...	7.5	12.00	...	13	3	4	W
Tobacco Fertiliser	...	21	C.S.M.L.	do.	do.	3.30	...	9.00	1.5	1.00	11.5	5.7	...	11	7	7	W
6. MISCELLANEOUS.	...	60	Summit Growth	L. M. McLeod	...	4.1	...	7.00	1.2	.1	8.3	Potash 12.2	...	*
Fertiliser Tablets	...	56	"Fauldings" Nightingale 10-10-5	F.H. Faulding & Co., Ltd. Wignores Ltd.	...	7.5	...	5.00	5.00	Potash 12.2	...	*
Liquid Manure	...	2	10.00	10.00	Potash 12.2	...	*
Liquid Fertiliser	...	70	Dawn	Dawn Nurseries	...	5.23	...	11.21	1.41	1.46	14.08	Less than 1.00	...	†
Plant Food	...	3	Wyndham	Wyndham Meat Works	...	6.00	6.5	9.00	15.5	13	6	0	P
B. ORGANIC	...	4	R.A.-A Sur-price	C. A. Kirkby & Sons	...	5.5	4.00	10.00	14.00	15	8	6	P
(a) Blood and Bone	...	26	C.S.M.L.	Cuming Smith & Mt. Lyell F.F. Ltd.	...	5.00	12.00	12.00	11	7	0	W
Do.	...	40	State Abattoirs Katoomba	State Abattoirs F.F. Ltd.	8.0	5.00	5.00	16	0	0	W
Animal Fertiliser	...	41	State Abattoirs Katoomba	do.	8.0	5.00	5.00	9	5	0	W
Do.	...	61	Ancho land Jet.	Anchorage Butchers Ltd.	7.5	...	2.6	8.8	11.4	13	15	6	P
Blood with Bone	...	62	Robbs	The W.A. Meat Export Works	14.00	14.00	10	11	2	W
Blood and Bone	...	63	Eclipse	do.	12.00	12.00	10	16	8	W
Do.	...	64	Albany	The W.A. Meat Export Works (Albany Branch)	6.0	10	16	8	W
Do.	...	65	Apollo	J. Kitchen & Sons Pty., Ltd.	7.0	...	9.0	5.0	14.00	10	16	8	W
Do.	...	1	Wattle	Wattle Fertiliser Co.	...	3.43	20.57	*
(b) Bone Dust.	...	37	Superhumus	William Austen	...	4.00	...	3.0	.5	6.5	10.00	*
General Purpose Bone Dust	...	38	do.	do.	...	2.00	...	1.8	5.0	.2	2.5	2.00	...	*
(c) Miscellaneous:	...	55	Sproutem	Kog Manufacturing Co.	5.0	...	4.00	9.00	*
Super Humus No. 2	...	58	Corno	Norwest Fertilisers	...	5.00	8.00	*
Do. No. 1
Garden Manure
Fish Fertiliser

* Contains minor elements.

† Price on Application.

‡ C.I.F. & E., Fremantle.

(P) at Perth.

(W) at Works.

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